CONTRACT NO. TC-3212

TETRA TECH

SMALL BOAT RECREATIONAL HARBOR FEASIBILITY STUDY

HIGHLAND PARK, ILLINOIS

FOR

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
CITY OF HIGHLAND PARK AND
THE PARK DISTRICT OF HIGHLAND PARK

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January 31, 1979

Mr. Mark Muggler
Deputy Program Manager
Illinois Department of Transportation
Division of Water Resources
300 North State Street Toom 1010
Chicago, Illinois 60610

Reference: Small Boat Recreational Harbor Feasibility Study - Highland Park, Illinois

Dear Mark:

In compliance with our contract, we are submitting the attached final report of the Small Boat Recreational Harbor Feasibility Study for Highland Park.

This report involves analysis of engineering, environmental and economic feasibility of a marina development at a designated site in the City of Highland Park. As a separate discussion, this report also examines the traffic impacts generated by the proposed marina development at two alternate locations: the Central Avenue site, near the City Water Works, and at the terminus of Walker Avenue.

The above study represents a comprehensive evaluation of all major concerns of the developmental feasibility of the proposed marina and makes recommendations for subsequent actions.

We enjoyed the interactive process of developing this study in cooperation with the Illinois Department of Transportation, the City of Highland Park, and the Park District of Highland Park. It was particularly gratifying to have the spirited participation and working

involvement of the residents of Highland Park.

Sincerely,

TETRA TECH, INC.

Guido Zemgals, A.I.A.
Manager
Engineering Design and Planning

GZ/sr

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FEBRUARY 1979

SMALL BOAT RECREATIONAL HARBOR FEASIBILITY STUDY

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INTRODUCTION

A. INTRODUCTION

1.0 Purpose of Study

This report presents results of a crossdisciplinary feasibility study encompassing planning, engineering, oceanography, economics and financial considerations for a contemplated Lake Michigan marina at Highland Park, Illinois.

The principal purpose of the study is to assess the physical, environmental and economic feasibility of constructing a small craft recreational marina at a given city owned site in Highland Park located adjacent to the water treatment plant. The results of this study will provide the City, the Park District of Highland Park and the State of Illinois Department of Transportation with the necessary decision making tools and clarification for most of the major marina development issues.

In the event the City, the Park District of Highland Park and the State decide to pursue the Highland Park Marina Development, subsequent objectives of this study are to provide substantiation for the key development issues; set general guidelines for the marina character, user's mix of facilities and the subsequent methods of development; provide a preliminary baseline for an Environmental Impact Report; and in general provide a broad set of guidelines for implementation of the project.

In addition to the above work, a separate traffic impact study was undertaken for the Central Park location and an alternate location of the marina at the easterly end of Walker Avenue. Results of this analysis element are presented in the Appendix - Traffic Impact Studies.

2.0 Objectives

As indicated before, the principal objective of this study is to evaluate the overall potential for development of the small-boat recreational harbor/marina at the proposed site in Highland Park. To achieve this objective, the study deals with the following key analysis tasks:

a. Evaluation of the need and general market demand for recreational harbor facilities and related commercial development, including restaurants, yacht club and boat launch and storage facilities.

b. Ascertaining that a marina development at this location will be environmentally compatible with the site, its immediate neighbors and the community in general.

c. Determination of the optimal size and mix of facilities to be developed for this location, including public access for recreation and fishing.

d. Determination that physical conditions and location of the site will permit efficient operation of the proposed facilities under varying lake levels and weather conditions.

e. Analysis of the magnitude of impact of access accommodations to the marina site during construction and operation.

f. Ascertaining the general economic feasibility of

the project under alternate size and scope assumptions, including requirements to be met for federal cost sharing.

g. Analyses of the projects potential impact on lake bottom and coastal processes in the area.

h. Potential for developing of marina facilities with minimum of structural solutions.

GENERAL BACKGROUND

B. GENERAL BACKGROUND

1.0 Background of the Area, the Project and the Site

The City

The City of Highland Park is located in Lake County on Lake Michigan, approximately 26 miles north of Chicago. It is surrounded by Lake Forest from the north, Deerfield and Bannockburn from the west, Glencoe and Northbrook from the south, and Lake Michigan from the east. See Figure 1 for local vicinity definition. The City was incorporated in 1868 and occupies some 7,738.87 acres or 12 square miles. It is linked with the surrounding areas by the Chicago and Northwestern Railroads with 28 southbound and 29 northbound trains daily, and Skokie Highway U.S. 41. Population according to 1970 census 32,263 projected to grow to 52,893 by the year 2000.

As indicated earlier, the eastern boundary of Highland Park, facing Lake Michigan, is situated on a bluff overlooking the lake. The bluff is roughly 100 feet above the lake level. A beach extends the entire length of the city along the lake front, interrupted by steel-piling groins perpendicular to the shoreline, placed at irregular intervals, and two structures protruding out into the lake--an abandoned sewage treatment facility at Ravine Drive and a water treatment facility at Central Avenue.

Most of the lake front--about eighty percent--is occupied by private residences. Public beaches are located at Moraine Park, Park Avenue, Ravine Drive, Cary Avenue, and Roger Williams Avenue. Only the Park Avenue and Cary Avenue

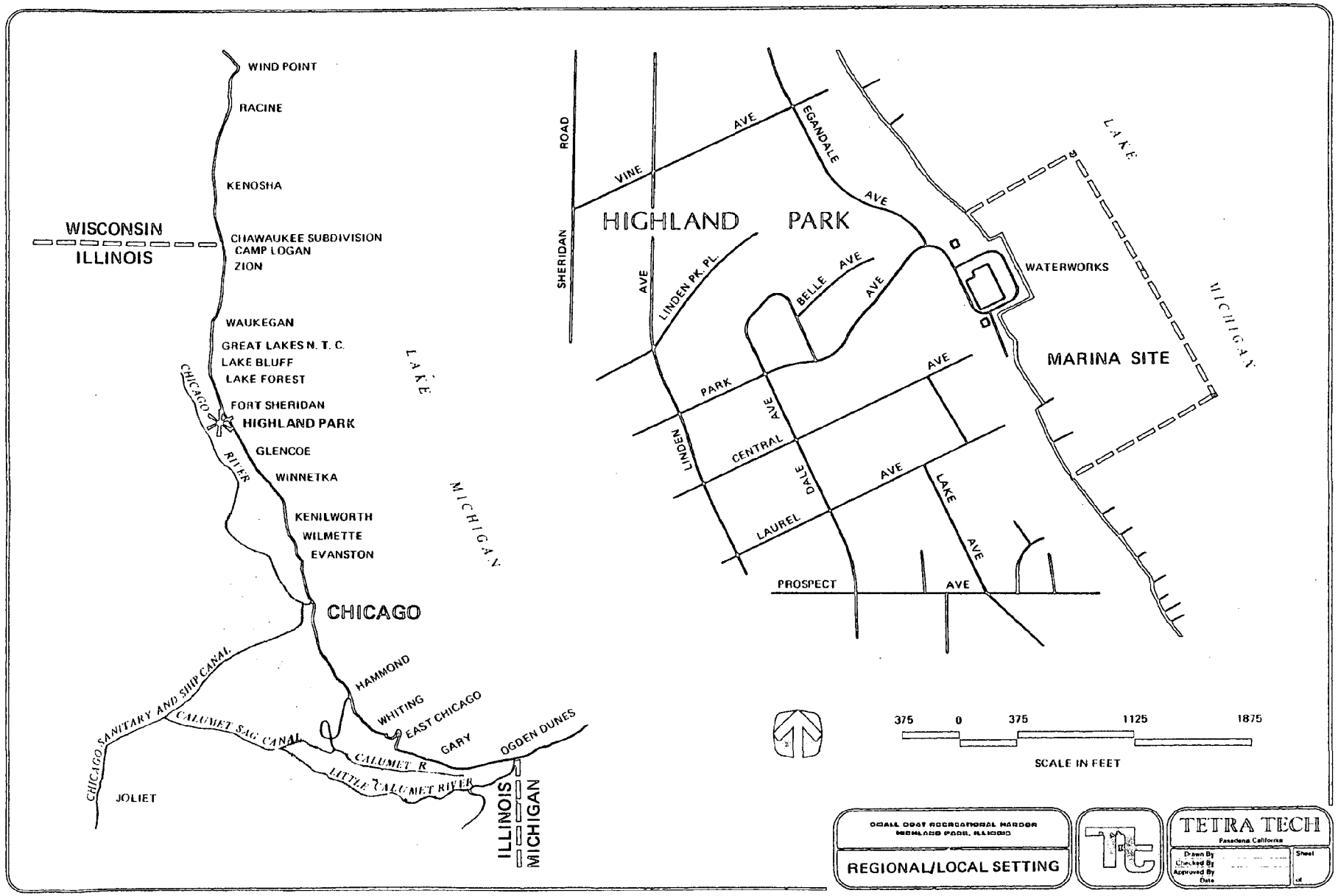


FIGURE 1 REGIONAL SETTING

Beaches have parking facilities and access streets at beach level.

The Project

A city wide survey conducted in 1965 by the Highland Park Harbor Commission indicated a need for 5000 boat moorings in the area. Subsequently, in 1970 an informal survey conducted by Dr. Mortimer D. Gross, submitted to the Highland Park Park District, showed some 200 local resident signatures on a petition wanting to establish a small boat harbor at Highland Park.

In 1974 the Highland Park Lake Front Commission was established by the City Council and charged with the responsibility to prepare a general plan dealing with lake front uses. The plan was to deal principally with:

- Land uses
- Erosion control
- Drainage
- Recreation
- Use ordinances
- Legal definitions

As part of this charge, the Commission issued a report in September 1975, defining some intended waterfront uses, including a set of long term recommendations which contained an offshore island/marina concept. The original intent was to have this offshore island function as an erosion control device, providing additional benefits such as bathing beaches, area for swimming, area for paddle boating and small-boat sailing, land for hiking, biking, picnicking and fishing.

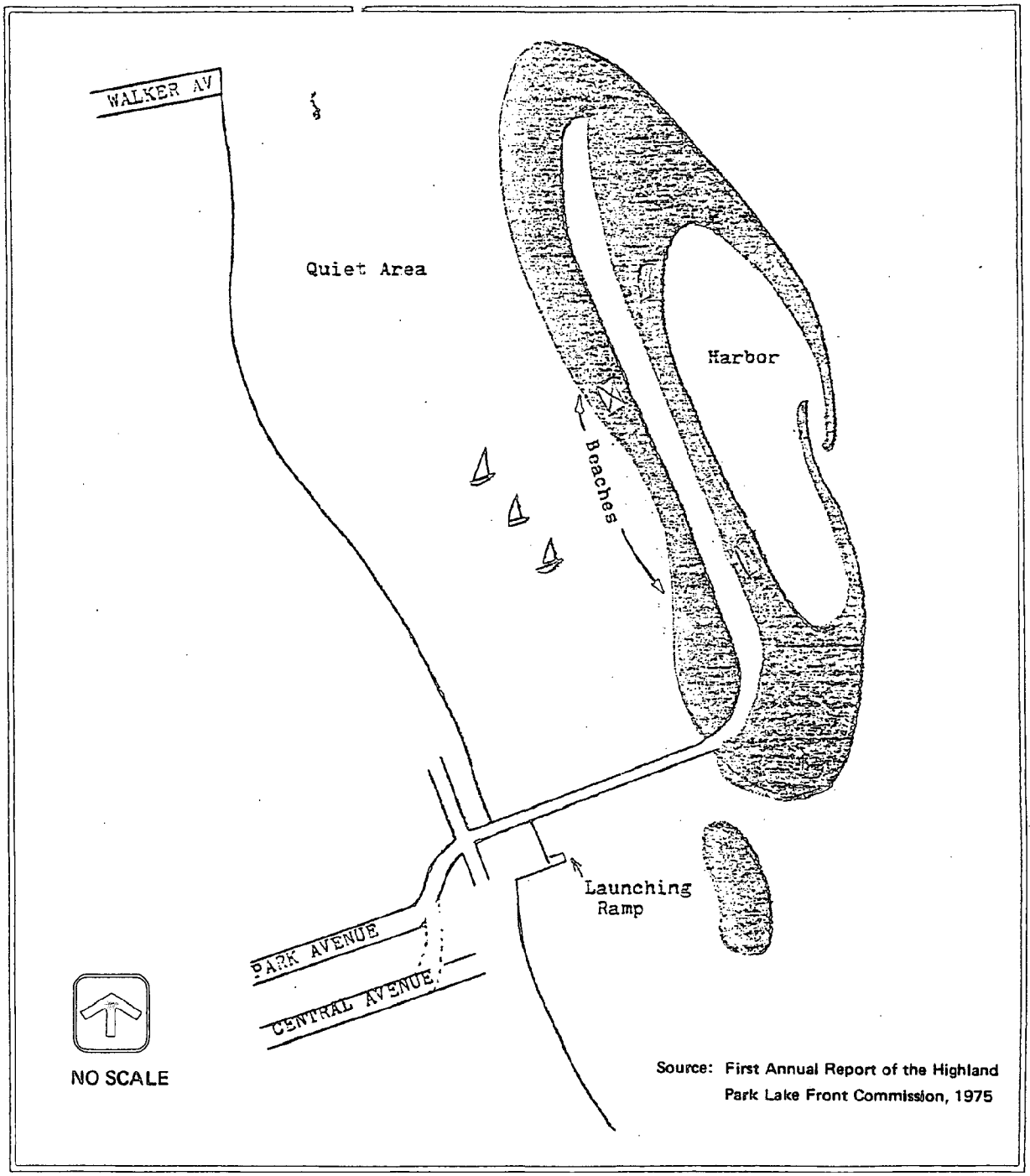


FIGURE 2 OFFSHORE ISLAND/MARINA SCHEME PROPOSED SEPT. 1975
BY HIGHLAND PARK LAKE FRONT COMMISSION

The proposed marina, of some 600 boat capacity, would also provide boat launching facilities and auxilliary parking.

It was assumed at this time that such an island/marina would cost in the order of 50,000,000 dollars. Figure 2 shows a schematic configuration of the proposed island/ marina concept.

In April, 1978 Illinois Department of Transportation, Division of Water Resources, in cooperation with the City of Highland Park and the Park District of Highland Park retained Tetra Tech, Inc. to undertake this Small Boat Recreational Harbor Feasibility Study.

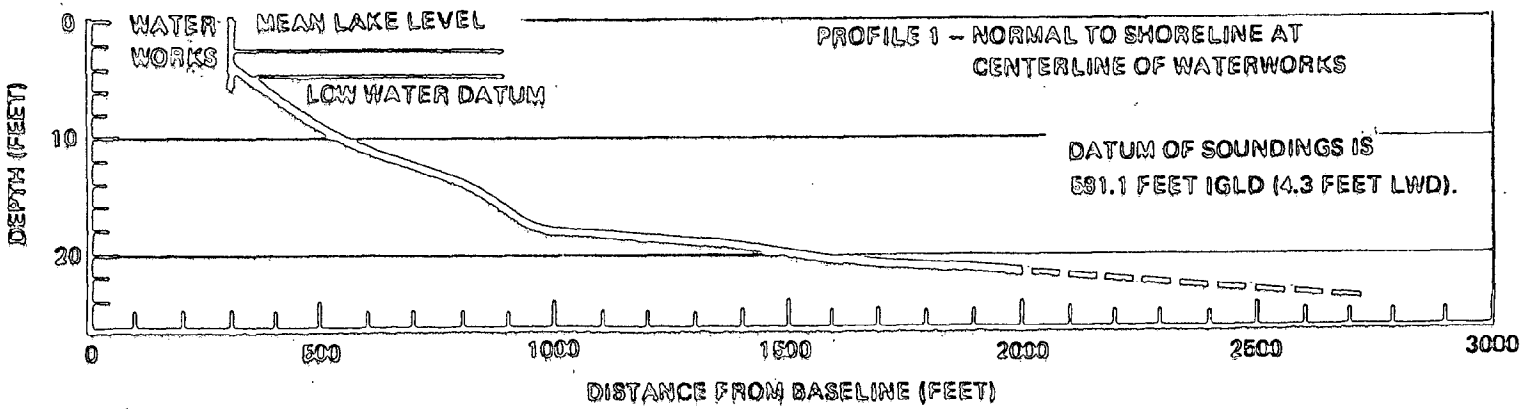
The Site

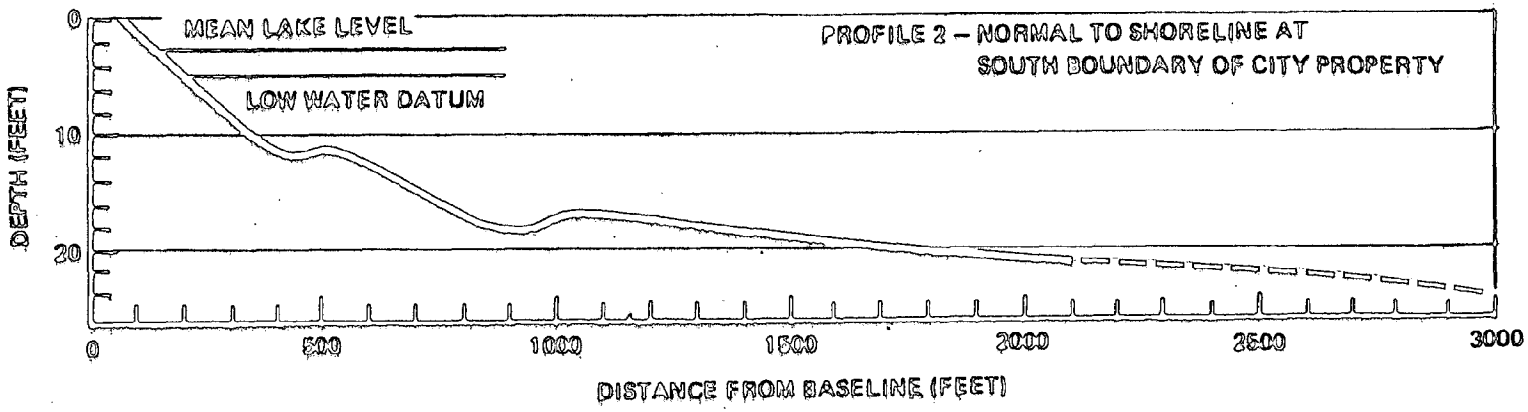
The site area selected by the Park District of Highland Park for the marina is located central to the city of Highland Park, at the easterly terminus of the Central Avenue right-of-way. The Park District of Highland Park owns approximately 1200 feet of lakefront property, southerly to the city water works.

Since the city owned beach front area is only 20' - 40' wide and is bounded on the west by a 60 to 75 foot high bluff along its entire length, the planning process for the marina has to consider facility development from the shore lakeward. Figure 3 shows the offshore contour profile at two locations for the proposed marina site area.

Access to the site is accommodated currently by a one-way narrow roadway (Park Avenue) descending through a heavily vegetated ravine; exit is provided by another narrow, one-way street (Egandale Road) through a residential area.

Figures 4, 5, 6 and 7 show the key physical features of the site area in their present state.





Source: Hydrography of the Lake Michigan Nearshore in Illinois, December, 1977.

FIGURE 3 OFFSHORE PROFILES AT MARINA SITE AREA

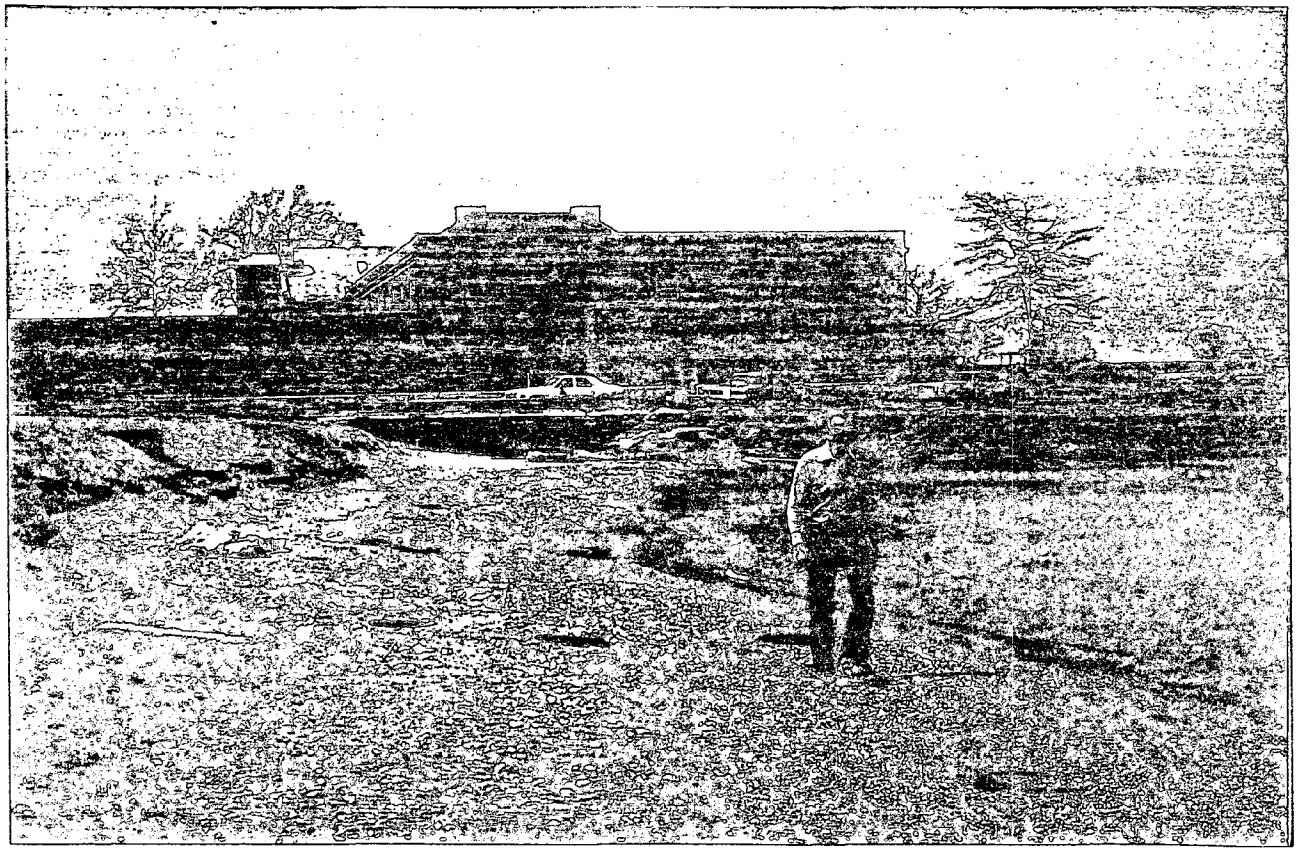


FIGURE 4 MARINA SITE AREA LOOKING NORTH TOWARDS HIGHLAND PARK WATER WORKS

FIGURE 5 MARINA SITE AREA LOOKING SOUTH FROM WATER WORKS

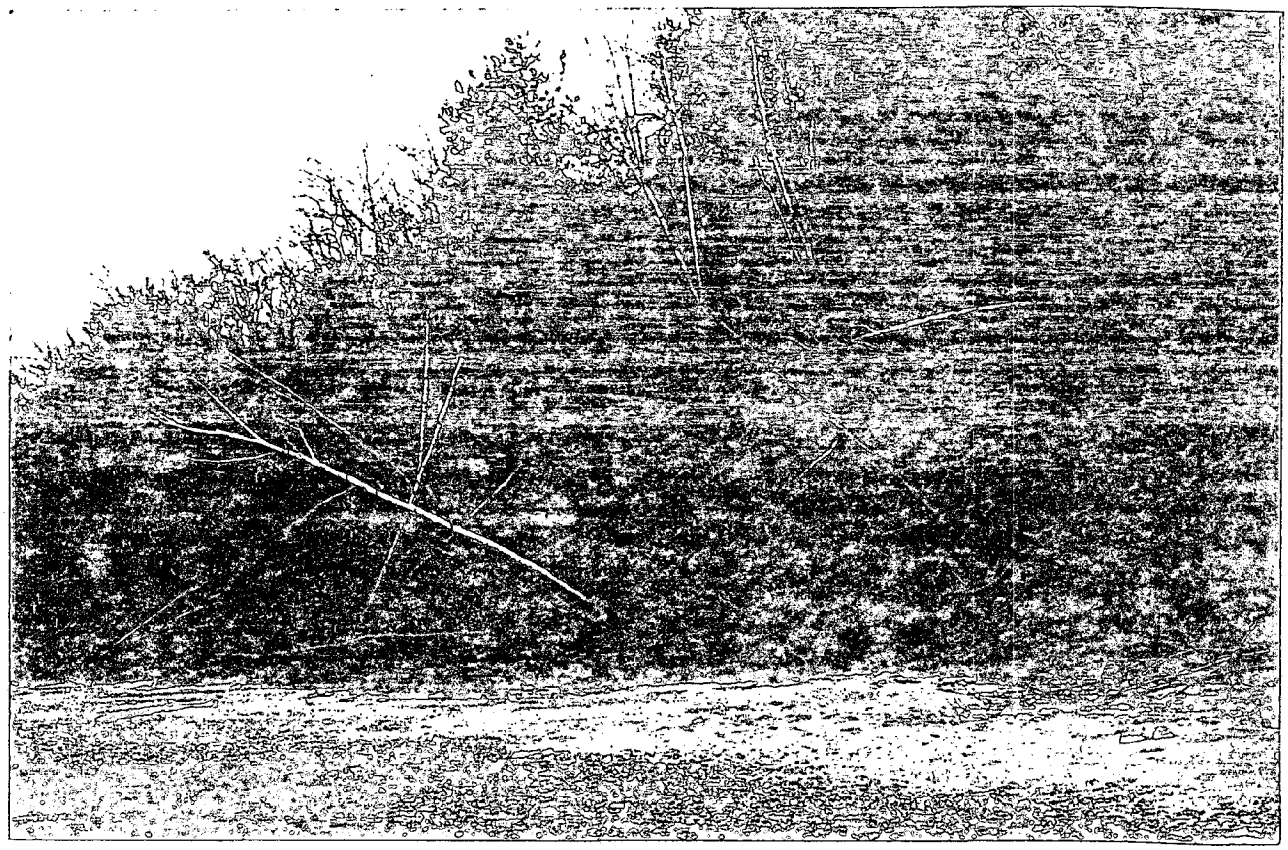


FIGURE 6 BLUFF, BOUNDING SITE AREA AT WEST , NOTE STORM–INFLICTED DAMAGE ON VEGETATION .

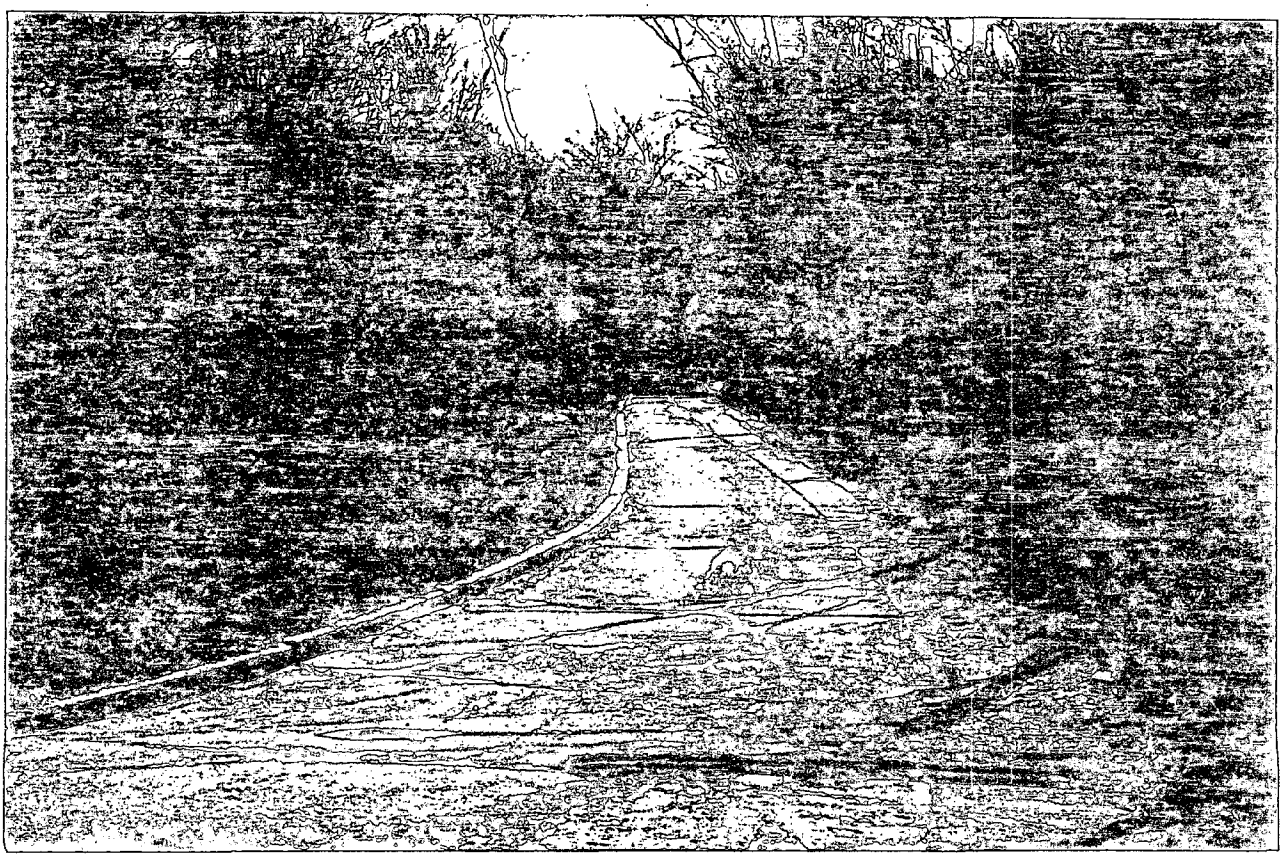


FIGURE 7 PARK AVENUE , ONE–WAY ACCESS ROAD LEADING TO SITE AREA

More specific discussion of the environmental features of the site are in Section D - Design/Planning Criteria.

2.0 Prior Studies

There are a number of studies and reports undertaken by various Federal, state and local agencies which are directly pertinent to this study. A listing and brief discussion of the most significant ones are given in this section.

City of Highland Park Reports

1. First Annual Report of the Highland Park Lake Front Commission, September, 1975

   Report on the activities of the Commission for the year 1974-1975. It deals with the basic issues of how the city's water front area should be used and administered. Principal issues are erosion control, public access and uses, ordinances and development control. A questionnaire dealing with riparian uses of land shows local preference for some types of development--primarily recreational. The report proposes a 600 boat marina/island concept to control erosion and provide recreational potential for local residents.

2. A Comprehensive Master Plan, City of Highland Park, Illinois, 1975

   Prepared for the City of Highland Park by Angelos C. Demetrious, A.I.A., this planning report defines basic land use patterns, zoning, community goals and general growth guidelines for the city as a whole. Its emphasis is on the central business district (CBD) development and it does not deal in depth with the shoreline development problems.

Corps of Engineers Reports

1. Lake Michigan Regional Boating Survey and Analysis, January, 1974

   A small-boat demand study completed by the Chicago District, this report deals with all major aspects of recreational harbor demand on Lake Michigan. It describes and analyzes the current use patterns on the lake and estimates the future changes in demand for Lake Michigan recreational boating facilities.

2. Section 107, Reconnaisance Report, Illinois Beach State Park, August, 1972

   Undertaken by the Chicago District this reconnaissance study concludes that construction of a small-boat harbor was economically feasible at the park location. This study was requested by the State of Illinois and conducted under the authority of Section 107 of the 1960 River and Harbor Act.

3. Illinois Coastal Zone Management Program, Volume III, 1976

   Conducted by the Chicago District this report deals with shore stability and beach bluff protection. Prepared for the Illinois Division of Water Resources under the Coastal Zone Management Act of 1972 this preliminary report recommends further investigation of major structure effects on littoral transport processes longshore and fine-tuning the littoral transport study methodology and drift rates.

4. Illinois Shore Study, 1949

Prepared under the authority of Section 2 of the River and Harbor Act of 1930 by the Chicago District, this report deals with determination of the extent of existing erosion problems, recommended methods for control and restoration of damaged areas. Estimates of erosion and accretion are made.

5. Survey Investigations and Reports EM 1120-2-113, Benefit Evaluation and Cost-Sharing for Small-Boat Harbor Projects, June, 1959

Definition of the presently acceptable basis for evaluation of benefits from recreational boating and sport fishing.

6. Digest of Water Resources Policies, January, 1975

U.S. Corps Policy Manual dealing with water resource development, prepared by Office of Chief of Engineers, Washington, D.C.

Other Agency Reports

1. Analysis of Recreational Land and Water Needs by Northeastern Illinois Planning Commission, May, 1976

A comprehensive study of recreational facility needs on Illinois' Lake Michigan shoreline. The study demonstrates that a large unmet need exists for water related facilities--specifically boating.

Study recommends expansion of Waukegan Harbor and development of Illinois Beach State Park for more intensive boating use.

2. Inventory of Physical Characteristics of the Illinois Shore North of Chicago, Illinois State Geological Survey, October, 1975

   An inventory of physical features along the Lake Michigan shoreline, including the Highland Park area.

3. Map Atlas Lake Michigan Shore in Illinois, Division of Water Resources, Illinois Department of Transportation, 1978

   Atlas of shoreline features, 100-year Recession Bluffline, shore ownership.

4. Hydrography of the Lake Michigan Nearshore in Illinois, Division of Water Resources, Illinois Department of Transportation, 1977

   Nearshore hydrography for Illinois Lake Michigan Coast.

5. Illinois Beach State Park Safewater Harbor Feasibility Study, State of Illinois, Department of Conservation, March, 1978

   Feasibility assessment for small-boat harbor at Illinois Beach Site Park.

6. Final Report of the International Commission for Sport and Pleasure Navigation, General Secretariat of PIANC, 1976

   General design standards for marinas.

3.0 Access to the Beach/Lake

Access for boating to the lake and beaches currently is accommodated in two principal ways:

1. Through seasonal moorings or berths in local marinas, or

2. Through launching ramps and trailers.

In the general vicinity of the proposed Highland Park Marina, within a 15 mile radius there are the following principal lake access points providing a varied mix of services and accommodations. See Figure 8 for access point location and specific details.

a. Waukegan Harbor
b. Great Lakes (non-public)
c. Wilmette Harbor
d. Montrose Harbor

Waukegan Harbor

Currently the small-boat marina at the harbor provides 110 slips, 35 moorings and 12 launch lanes. Waukegan Harbor is one of the larger waterfront facilities in the area, serving principally as a recreational harbor.

Its 12 launch lanes are being heavily used, since they are the major launch facility in the general area.

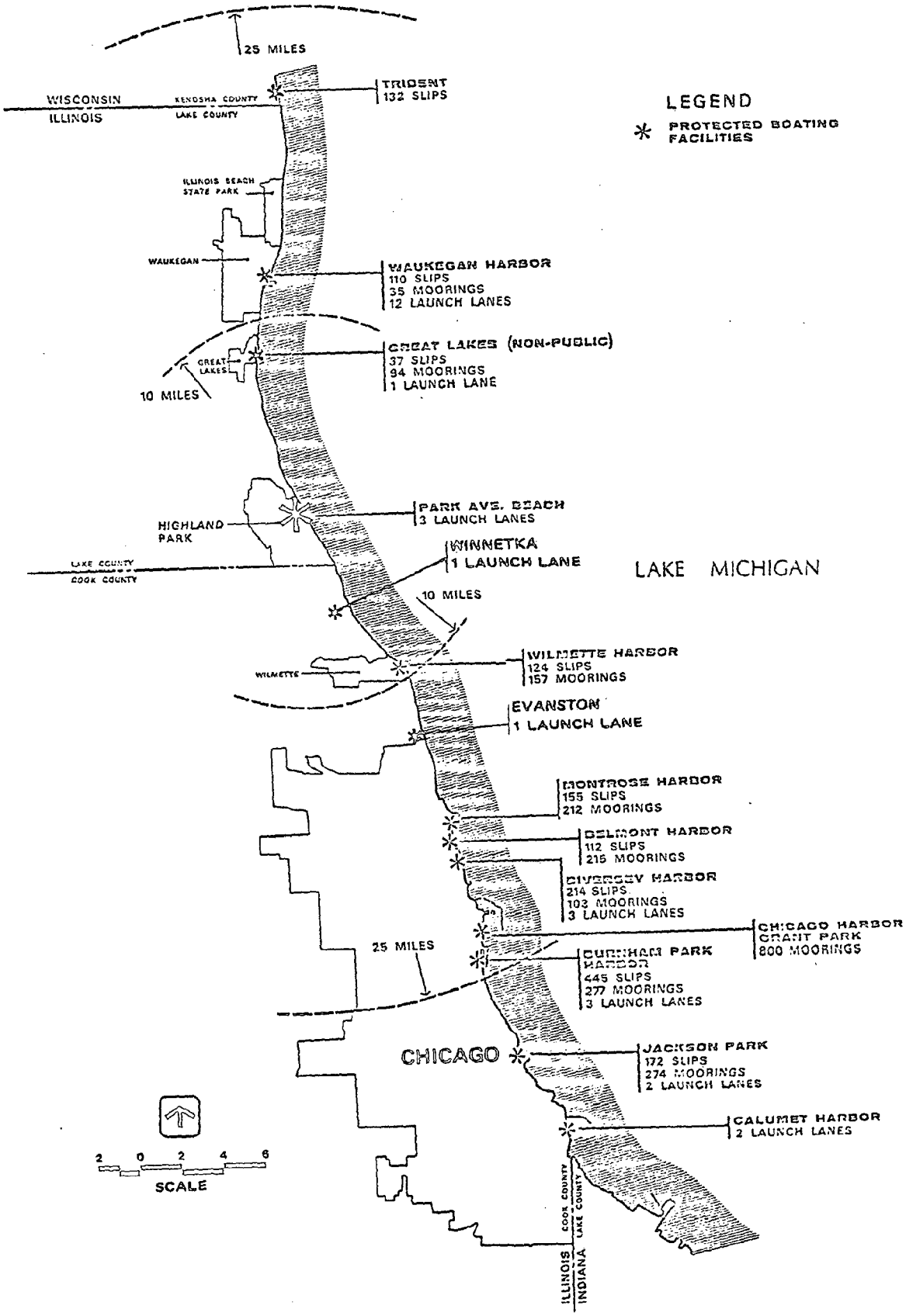


FIGURE 8 LAKE ACCESS POINTS AND COMPETING FACILITIES

A proposal exists currently to expand this small-boat marina to 1000 slip capacity. To date funds have been appropriated for this project.

Great Lakes Naval Training Center

This marina facility, located just north of Highland Park, is not open for public use and therefore does not count as a competing recreational resource for the area.

Wilmette Harbor

Located approximately 10 miles south of Highland Park this small-boat harbor provides 124 slips and 157 moorings. No launch facilities are available at this time.

Montrose Harbor

This harbor, part of Chicago proper, provides 155 slips, 212 moorings and no launch lanes. Much of its boating traffic is local in nature, facilitating boating needs in its immediate service area.

Illinois Beach State Park Proposal

Currently planning is in motion analyzing the feasibility of a major inland marina/safe water harbor at Illinois Beach State Park. Sizes proposed range from 500 to 1500 slip capacity, each with some economic and environmental consequences. However, no specific plans have presently been solidified.

Currently Tetra Tech is under contract to review existing tentative shore connected marina development plans and to develop alternative siting schemes providing beach erosion protection for the area.

Construction of this large marina would have a significant initial effect on the proposed Highland Park Marina, but the long term effect would be negligible.

4.0 Demand for Boating Facilities in the Area

The recent analysis of boating in Lake Michigan conducted by the Corps of Engineers estimated the current and future demand for additional boat storage and launching facilities along the western shore of the lake. This study, the Lake Michigan Regional Boating Survey and Analysis (January, 1974), dealt with demand for and availability of facilities in 63 existing harbors from Escanaba Harbor in Upper Michigan to Benton Harbor in Lower Michigan, including Green Bay and Lake Winnebago in Wisconsin. Since the demand projections for facilities of these harbors are not independent of one another, the harbors were treated together as a complete system.

For this reason, an analysis of the demand for boating facilities in Highland Park cannot be made independent of the facilities and plans for such nearby areas as Wilmette and Waukegan, for example. In the Corps study, the harbors at Highland Park and Wilmette were linked together in their determination of current and projected excess (unsatisfied) demand for berthing and launching facilities.

In the Highland Park-Wilmette harbors, the 1974 study shows the following facilities to exist (as of 1972):

	Permanent Storage Spaces				Launch Lanes
	Slips	Moorings	Dry	Total	
Highland Park	0	0	60	60	3
Wilmette	124	157	39	320	0
Total	124	157	99	380	3

(excludes facilities in unprotected harbors)

Similarly, in the nearby area to the north, which includes the protected harbors at Waukegan and Great Lakes, the 1972 inventory was as follows:

	Permanent Storage Spaces				Launch Lanes
	Slips	Moorings	Dry	Total	
Waukegan	110	35	64	209	12
Great Lakes	37	94	0	131	1
Total	147	129	64	340	13

(excludes facilities in unprotected harbors)

The Corps study developed estimates of unsatisfied (excess) demand by geographic locations*. These estimates were based on owner survey date, boat ownership data, registration records, and the predicted future changes in median family income, population, and travel times to boating area. For

*Definition of "excess demand": The quantity or number of potential boaters that would likely appear if the supply of harbor facilities were not fixed at its present level and if the price or costs of using these facilities were fixed at its present level.

those persons within the "boating population" who have attempted to secure permanent storage space for their boat at a harbor and have been unsuccessful, it is obvious that an "excess demand" exists today. The present and future needs for both permanent storage and launching lanes were analyzed in the study.

Permanent Storage Facilities

The 1974 study for the Corps estimated this current supply shortage for those harbors in the vicinity of Highland Park as follows:

Permanent Storage Spaces (1974)

	Present Supply		Required Spaces	Shortage = Present Excess Demand
Highland Park	60	380	560	180
Wilmette	320			

The forecast of future storage space requirements was developed from two categories of growth, i.e., growth caused by expected population and income changes and additional growth induced by the knowledge of potential boat owners that the supply of permanent storage spaces is being increased. That is, the construction or expected construction of berths and moorings encourages additional purchases of boats by individuals with the hope of eventually using the new facilities. Using selected statistical analysis techniques, the Corps of Engineers was able to predict growth in both categories. The results of their analysis were as follows:

(for Highland Park and Wilmette)	Excess Demand for Permanent Local Storage Spaces			
	Present	1980	1990	2020
Due to changes in population and income	180	235	300	420
Due to induced demand	0	65	130	240
Total	180	300	430	660
Type of Facility:				
Berths (slips)	140	200	270	390
Moorings	40	100	160	270
Total	180	300	430	660

A breakdown of the excess demand by size of boat is shown below (based on size mix at adjacent harbors):

(for Highland Park and Wilmette)	Excess Demand for Permanent Storage Spaces			
Berths (slips)	Present	1980	1990	2020
A. 16'-25' Length Boats				
16'-18'	12	17	23	33
19'-21'	11	16	22	32
22'-25'	16	22	30	43
Total	39	55	75	108
B. 25'+ Length Boats				
26'-29'	29	41	55	80
30'-33'	30	43	58	84
34'-37'	20	29	39	56
38'-41'	11	16	22	32
42'+	11	16	21	30
Total	101	145	195	282
Total Berths	140	200	270	390

	Present	1980	1990	2020
Moorings				
A. 16'-25' Length Boats				
16'-18'	2	6	10	16
19'-21'	2	6	9	15
22'-25'	4	8	12	22
Total	8	20	31	53
B. 25'+ Length Boats				
26'-29'	9	23	37	61
30'-33'	10	24	39	65
34'-37'	6	16	26	43
38'-41'	4	9	15	25
42'+	3	8	12	23
Total	32	80	129	217
Total Moorings	40	100	160	270

Launching Lanes

The Corps performed a similar analysis of trailered boats and launching lanes along the western Lake Michigan shore. The physical capacity of launching lanes (boat launchings per season) varies as to harbor location, due to the varying length of the boating season. In Illinois, it was assumed that 2500 launches per season could be handled by a single launching lane.

Within the Highland Park-Wilmette region, the current inventory of launching lanes is 4, 3 in Highland Park and one in Wilmette. The present local excess (unsatisfied) demand has been estimated at 3 lanes. This shortage is projected to increase to 4 lanes in the year 2020. This includes the additional demand induced by the construction of new launching lanes in the area.

Local Highland Park-Wilmette Market

The projections developed by the Corps grouped harbors according to their geographical proximity and pattern of use similarities. Consequently, Highland Park and Wilmette were analyzed as a single unit; to determine the local market profile of Highland Park requires that consideration be given also to the plans for Wilmette Harbor.

According to a recent study by the Northeastern Illinois Planning Commission (NIPC)*, the Village of Wilmette's Comprehensive Plan calls for the expansion of mooring capacity at Wilmette Harbor. Furthermore, the plan also states that a boat launching ramp is not recommended at the harbor. Additional launching ramps and dry storage are recommended at Langdon Park in Wilmette. The NIPC further concludes the "The Wilmette Harbor should be improved for boating by the provision of enlarged facilities." No recommendation is given as to the magnitude of the suggested enlargements, although physical limitations at the harbor may severely constrain the extent of the expansion.

Assuming that expansion at Wilmette Harbor is limited to additional moorings, and that launching ramps and dry storage may be added at Langdon Park, then the balance of the local excess demand may accrue to the Highland Park Harbor, if facilities are made available at that location. Therefore, a preliminary evaluation of the local need for boating facilities at Highland Park was developed as follows:

*Analysis of Recreational Land and Water Needs, by Northeastern Illinois Planning Commission, dated May 8, 1976.

	Excess Demand			
	Present (1974)	1980	1990	2020
Permanent Storage Spaces				
1. Berths (slips)				
Total New Required	140	200	270	390
Less: Wilmette (New)	0	0	0	0
Highland Park	140	200	270	390
2. Moorings				
Total New Required	40	100	160	270
Less: Wilmette (New)*	0	50	50	50
Highland Park	40	50	110	220
3. Dry Storage: No estimate made by Corps of Engineers.				
Launching Lanes				
Total New Required	3	3	3	4
Less: Wilmette (New)*	0	1	1	1
Highland Park	3	2	2	3

Illinois Market

The demand by the balance of Illinois for additional protected boating facilities on Lake Michigan must also be considered in a market assessment, since in the absence of significant new harbor development elsewhere in Illinois, a Highland Park project could attract customers from Chicago to the south and Wisconsin to the north. Therefore, the total excess (unsatisfied) demand from Wisconsin to Indiana, as developed in the Corps study, was identified. This is as follows:

*Assumed figure, based on limited available information.

	Excess Demand			
	Present (1974)	1980	1990	2020
Permanent Storage Spaces				
1. Berths (slips)				
No. Lake County[1]	225	325	440	590
Chicago[2]	780	1350	1930	3100
Total	1005	1675	2370	3690
2. Moorings				
No. Lake County[1]	70	180	300	430
Chicago[2]	490	600	700	950
Total	560	780	1000	1380
Total Permanent Spaces	1565	2455	3370	5070
Launching Lanes				
No. Lake County[1]	13	1	21	27
Chicago[2]	17	3	32	39
Total	30	50	53	66

Total Market

In summary, the magnitude of the need for permanent storage spaces and launching lanes is as follows:

[1]Includes Trident Harbor on the Wisconsin side of the state line, Waukegan Harbor, and Great Lakes.

[2]Includes 6 harbors in Chicago.

	Excess Demand			
	Present (1974)	1980	1990	2020
Permanent Storage Spaces				
1. Berths (slips)				
Local Highland Park Wilmette	140	200	270	390
Balance of Illinois	1005	1675	2370	3690
Total	1145	1875	2640	4080
2. Moorings				
Local Highland Park Wilmette	40	50	110	220
Balance of Illinois	560	780	1000	1380
Total	600	830	1110	1600
Total Permanent Spaces	1745	2705	3750	5680
Launching Lanes				
Local Highland Park Wilmette	3	2	2	3
Balance of Illinois	30	50	53	66
Total	33	52	55	69

Demand Summary

From our analysis of the market data, it appears that 3 alternate development schemes deserve further evaluation. These are:

1. Local Market Scheme: Satisfies identified local market needs only; minimum size; mix as follows:

Berths (slips)	-300±
Moorings	-200±
Launch Lanes	- 3

2. Intermediate Scheme: Modest size harbor designed to satisfy local and some regional needs; mix as follows:

Berths (slips)	-600±
Moorings	-300±
Launch Lanes	- 10±

3. Regional Scheme: Satisfies anticipated regional (State of Illinois) needs for foreseeable future; mix as follows:

Berths (slips)	-1500±
Moorings	-1000±
Launch Lanes	- 25±

The size mix for berths and moorings is expected to be as follows:

Boat Lengths	Berths and Moorings
16 ft. to 18 ft.	8.3%
19 ft. to 21 ft.	7.9%
22 ft. to 25 ft.	10.7%
26 ft. to 29 ft.	20.7%
30 ft. to 33 ft.	21.9%
34 ft. to 37 ft.	14.6%
38 ft. to 41 ft.	8.3%
42 ft. +	7.6%
Total	100%

5.0 Principal Planning/Community Concerns

This feasibility evaluation of the proposed small-boat harbor has been structured around a number of key planning and community concerns, all of which need to have a clear definition and conscientious planning interpretation.

Although this planning analysis task can be pursued from a number of points of view, two perspectives are essential to a clear synthesis and integration of all principal concerns:

a. Local resident/community concerns--primarily because the marina development will directly and indirectly affect their immediate living environment, property values and area economics, and

b. General planning concerns--because a broader, more comprehensive and area representative view must be taken to balance the high intensity of local concerns, and provide some representation for the regional boating public.

Lake Michigan is a unique and valuable state resource, access for its recreational use and enjoyment by public should be considered essential and key to any marina feasibility study.

Specific concerns dealt with in this study can be identified as follows:

Community Concerns/Values

1. Visual changes imposed to the beach area by a man-made development such as a marina.

2. Boating/visitor vehicular traffic effects on the residential areas adjacent to the beach.

3. Change of character to the community due to introduction of boating public and marina visitors/users.

4. Potential for vandalism precipitated by influx of public from outside of community.

5. Noise generated by marina users and associated boating activities.

6. Effects of marina development on natural coastal processes, principally beach erosion.

7. Direct and indirect cost of development to the residents.

Planning Concerns

1. Public access to the lake for water oriented recreation.

2. Traffic accommodation in area/parking.

3. Protection of beaches from erosion.

4. Environmental compatibility of marina development with site and environs.

5. Effects on property values in the area.

6. Secondary growth effects, particularly in the community of Highland Park.

7. Aesthetic/visual improvement of beach area.

8. Overall functioning of proposed facilities.

9. Economic viability of project.

Above concerns have been addressed in this feasibility study, with an attempt to balance these values and without imposition of the analysts own bias. Issues have been addressed with an objective, open and unpredetermined mind to the extent possible, to provide the community and its leaders with a useful decision making tool.

AREA RESOURCES

C. AREA RESOURCES

1.0 Regional Description

Population

The population of Lake County has steadily increased, going from 293,656 persons in 1960 to 375,055 persons in 1970. The January 1, 1978 estimate of population places it at 410,700 persons, according to the Rand McNally 1978 Commercial Atlas and Marketing Guide. This amounts to a modest 1.84 percent annual compounded growth rate during the 1960 to 1978 period.

Economics

The Lake County economic profile is one of relatively high income and spending levels. For example, the mean household income for 1978 is estimated as follows:

Lake County	- $26,747
Cook County	- $20,782
Kane County	- $20,440
McHenry County	- $20,946
Kenosha (Wisc.) County	- $18,784

Retail sales per household in 1978 are estimated as follows:

Lumber and hardware	$ 807
General merchandise	1,412
Food	2,671
Auto	3,359
Gasoline	1,172

Apparel	$ 683
Furniture	531
Eating & drinking places	1,167
Drugs	460
Other	2,039
	$14,301

The development of a marina in Highland Park will have a moderate effect upon the economic base of Lake County and Highland Park, in particular. Those categories of retail sales which will be most affected by the operation of a marina facility will be general merchandise, gasoline, and eating and drinking places. Seasonal employment increases and their indirect and induced effects will similarly be moderate in size.

2.0 Natural Processes

Climate

Temperatures in the project area have an annual average of about 50°F, with low and high monthly extremes of respectively 26° and 76°F in January and August. The lowest recorded temperature was around -16°F and the highest 104°F.

Annual precipitation averages 33 inches. Snowfall normally occurs between December and March, averaging 38 inches annually.

Winds are characterized partly by migratory extratropical cyclones which dominate this area between late fall and early spring, and partly by a lake breeze season during

July and September. There are a few months of transitional period between these two characteristic wind patterns. During boating season between mid-April through mid-October, wind is generally dominated by lake-breeze system.

Wind patterns in the project area are considered to parallel those in the Chicago region. Wind statistics taken at Mid-way Airport (1948-1972), Chicago, and at Navy Pier (1932-1946), Chicago, indicate that there are distinctively more frequent occurrences of wind westerly (from land) than easterly directions. Maximum sustained wind during the periods of the above records attained about 50 mph, blowing from northeast and south.

Lake Water Levels

The lake level of Lake Michigan fluctuates with multi-year and seasonal cycles. A history of lake levels since 1860 is shown in Figure 9 . The lake levels are expressed in feet above mean level at Fasher Point, Quebec or International Great Lakes D tum (IGLD), 1955.

The seasonal cycle generally exhibits a range of about 1 foot, with a high in early summer and a low in mid-winter. Multi-year lake level fluctuations are erratic in periodicity and are not necessarily predictable. It has been noted that these longer term fluctuations would occur at between 6 to 30-year cycles. The recorded multi-year fluctuations exhibited an extreme range of 6.5 feet between a low of 575.4 IGLD in March, 1964 and a high of 581.9 IGLD in July, 1886. A maximum recorded range within a single given cycle occurred recently, between a low of 575.5 IGLD in 1964 and a high of 581.0 IGLD in 1973 and 1974, a range of 5.5 feet over a period of 9 years.

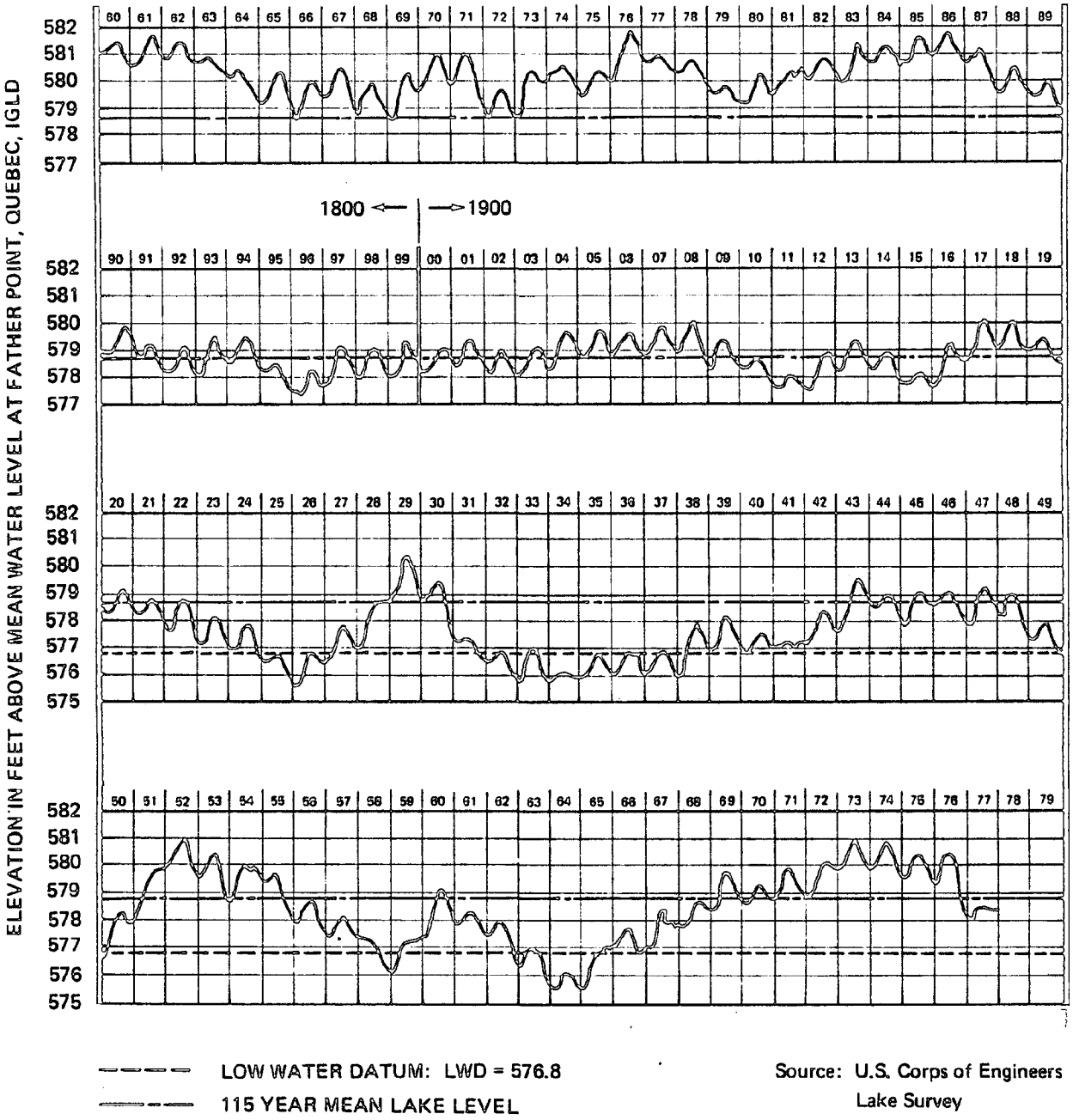


FIGURE 9 LAKE MICHIGAN HYDROGRAPH

It is noticed in Figure 9 that the lake level rarely exceeded 581.0 feet IGLD or +4.2 about Low Water Datum (576.8 feet IGLD). The last time this level was exceeded was in 1887, about 90 years ago.

However, in determining the design lake level, a consideration must be given to short-term temporary fluctuations associated with wind set-up, in addition to the seasonal and multi-year cycles. These short-term fluctuations could cause a water level rise of between 1 and 2 feet on the average once a year at the project site.

According to a lake level statistic which combined all these effects of lake level fluctuations during a recent 72-year period (to 1972), compiled by the Corps of Engineers Detroit District, a lake level of 10-year recurrence period is 581.1 IGLD, or +4.3 feet LWD. It is apparent that this level is exceeded at 9 to 10-year recurrence interval only by temporary rises due to wind set up, rather than by the sustained seasonal or multi-year lake level fluctuations. For this reason, we will consider a lake level of 581.1 IGLD as an acceptable risk and adopt it as the design lake level for this study.

Ice

The littoral zone in the project area is characterized by an ice field during late December through mid-March. The ice field prevents waves to reach a nearshore area, thus the littoral processes remain dormant during this 3.5-month ice season. The ice would not normally cause appreciable damages to beaches or ripraps, but may impose excessive horizontal and vertical loads to timber, concrete or steel structures.

Waves

Waves in the study area are characterized by local wind field, hence are governed by the wind speed, duration and fetch lengths. No actual measurements are available, hence the waves must be estimated from semi-empirical prediction formulae using these three parameters as input. Wave forecasting technique is a continuously evolving art, and its results cannot be fully depended upon for accuracy until they are verified by measurements.

In the present study, a three-year wave hindcast data during an ice-free season for Milwaukee and Chicago by Saville (Beach Erosion Board Technical Memorandum No. 36) was used to estimate wave statistics at Highland Park. According to this data, wave characteristics of 10-year recurrence intervals are around 12 feet in height and around 8 seconds in period, arriving from N 60^{O} E. In correspondence with the choice of 10-year recurrent lake level as a design lake level, this wave (12 feet high, 8 seconds in period, N 60^{O} E in incidence) of 10-year recurrence frequency was chosen as design wave for this study.

Littoral Processes

According to the surveys by the Illinois State Geological Survey in 1976, the lake bottom fronting the Highland Park area between Walker and Lakewood Avenues is only sparsely covered with sand, with majority of the bottom denuded to the glacial till layer, see Figure 10. A narrow strip of sand veneer only up to 10 feet thick exists between the shoreline and the tips of the groins. Beyond this zone, sand veneer thins rapidly offshore and virtually disappears at an average depth of about 10 feet.

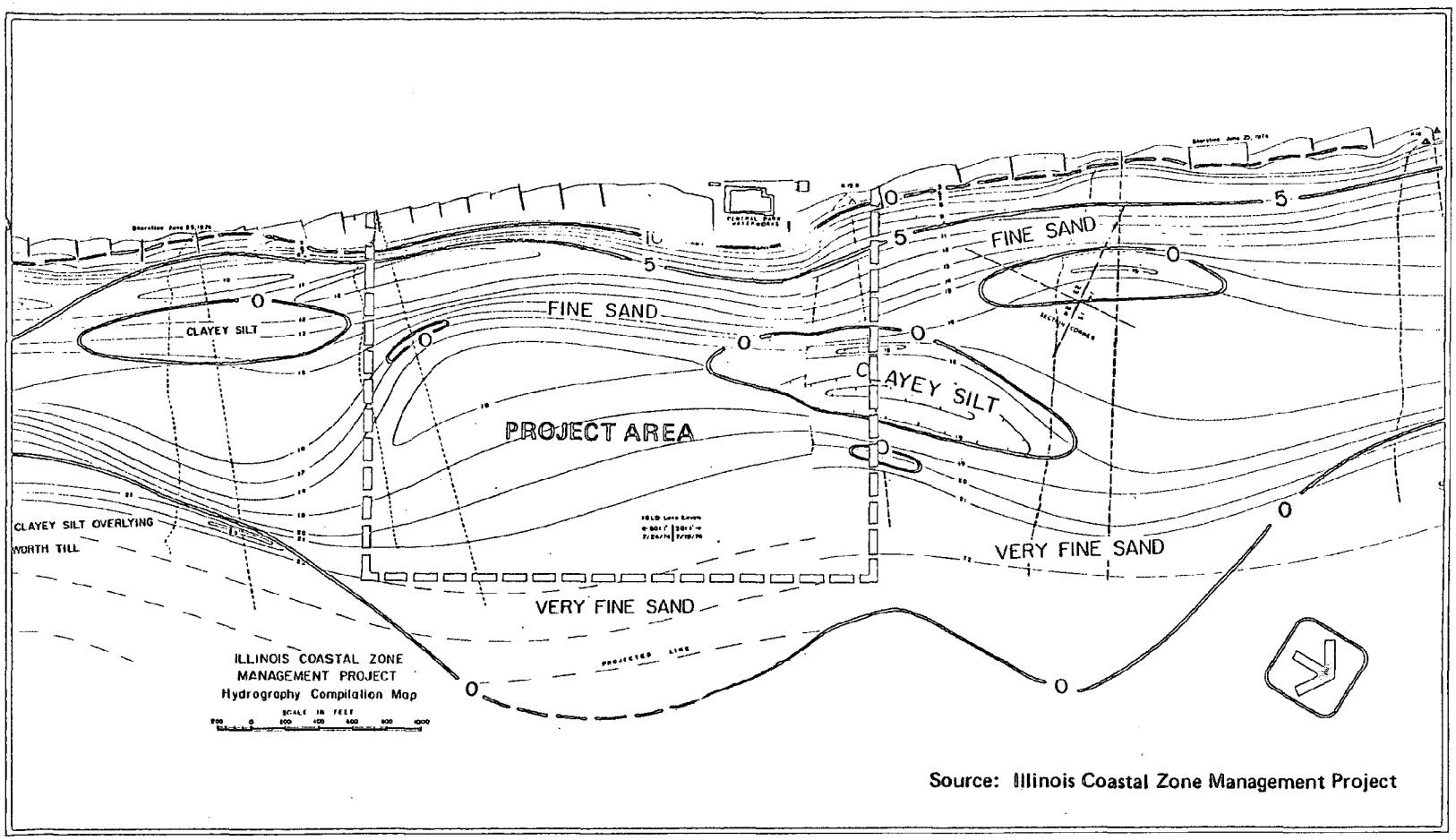


FIGURE 10 LAKE BOTTOM CONDITIONS AT MARINA SITE AREA

The lakeshore processes in the study area is suffering from the fundamental deficit of littoral material. Between 1872 and 1910, the period prior to the construction of major harbor structures at Waukegan and Great Lakes Naval Training Center, the lake bottom profiles in of Highland Park were accreting at an average rate of about 8 cubic yards a year per every foot of shoreline. In the recent 30-year period between 1946 and 1975, the bottom profiles have eroded at an average rate of about 6 cubic yards a year per every foot of shoreline. Considering an average distance of 1600 feet between the shoreline and the 20-foot contour, this erosion rate means that the lake bottom profiles have been dropping at an average annual rate of 0.1 foot. In other words, during the past 30 years the lake bottom dropped 3 feet between the shoreline and the 20-foot contour. It is thus reasonable to state that the shoreline in the study area is now preserving a precarious stability by virtue of a strip of sand up to 10 feet thick which remains arrested in the groin field.

Littoral drifts in the study area has been estimated variously. Using a wave energy flux method, a potential littoral drift rate at the Highland Park area was estimated by the Corps of Engineers (1976) to be on the order of 30,000 cubic yards a year. This amount is a potential drift confined to the surf zone, which will be realized in its full amount only when sufficient supply of littoral material exists in nearshore and beach zone. In the presence of a groin field, it is reasonable to assume that the potential littoral drift in the surf zone is diminished by, say, 30 percent. Thus, the resultant potential drift in the surf zone would become about 20,000 cubic yards a year.

In the absence of longshore bars, as is the case in the study

area, the littoral drift is expected to be active over a wide area between the shoreline and an offshore bottom beyond the surf zone. Under this condition, a sediment budget analysis, based on the rate of supply of material from the eroding lake bluffs in the study area, gives an estimated drift rate of approximately 50,000 to 60,000 cubic yards, (House Document 28/83/1). A more recent estimate by the Corps of Engineers (1976), based also on the local bluff erosion rate, places the littoral drift rate at about 30,000 cubic yards a year.

It is evident that an accurate determination of littoral drift rates requires a further study. For the purpose of this study, we have set a design littoral drift rate at 60,000 cubic yards a year between the shoreline and an offshore point 22 feet deep LWD. Furthermore, using an assumption that a drift rate at any given point of the profile is inversely proportional to the water depth at that point, littoral drift rates at different zones away from the shoreline were estimated. According to this computation, estimated littoral drift rates were approximately 30,000 cubic yards a year between the shoreline and a point 200 feet away, approximately 10,000 cubic yards a year between a point 200 feet and a point 400 feet from the shoreline, and approximately 20,000 cubic yards between a point 400 feet and a point 1300 feet from the shoreline.

DESIGN/PLANNING CRITERIA

D. DESIGN/PLANNING CRITERIA

1.0 General Criteria, Facility Mix

The water use associated activities recommended for the Highland Park Marina were selected from a broad range of recreational and social opportunities related to the marine environment to be utilized by the area residents. A general listing of activities and services considered include the following:

- o Yacht Club - Public house, meeting rooms, parking
- o Restaurant - Viewing terraces, boat owner's lounge, parking
- o Harbor Master Office Coast Guard Office - Weather forecast board, marine office, information, maintenance and storage, staff room, radar, communications mast, security station
- o Storage/Boatside Facilities - Storage lockers, restrooms, showers, bottled gas, electricity, lighting and power, phone service, solid waste bins
- o Services - Gas, bottled or in bulk, lighting and power, sewage and refuse disposal, water, telephones, security
- o Boat Services - Boat building, repair and maintenance, material storage, launching and hauling equipment, (fixed and mobile) launching ramps and slips, dry boat storage, covered moorings, divers services, fueling station
- o Related Facilities - Rowing, water-skiing, swimming, fishing, SCUBA diving, biking, hiking, picnicking, camping, outdoor recreation-education

- o Public House/ Community Recreation Center - Snack bar, storage, restrooms, meeting rooms, information, fishing and tackle shop, sports shop, boat rentals
- o Transportation - Car parking and service, trailer bays, train/shuttle stop, motorcycle/bicycle sheds, boat charter trips
- o Safety Facilities - First aid post, observation platform, fire-fighting equipment, life saving equipment, warning lights, navigation lights, general security, police, deicing equipment, weather and tides information
- o Miscellaneous - Beaches, paved and grassed areas, landscaping, swimming bay

These activities are shown on the following Table 1 for the 3 marina sizes considered initially. The activities identified were reviewed and determined as feasible for those particular size marinas.

2.0 Size Criteria

Three marina sizes were considered ranging from 250 berths to 1000 berths. The average harbor with all slip moorage can berth about 15 to 20 boats per acre of navigable water area including the main interior channel, fairways, and slip areas. Three vehicle parking spaces are required every four boats in the berthing area, and about 90 cars can be parked in one acre so roughly 1/6 of an acre of parking is required for each acre of water area in the marina. The land area required for support facilities is estimated at 50 percent of the total water area needed.

Marina size/boat capacity and principal advantages and disadvantages for each size are summarized in Table 2.

TABLE 1 GENERAL MARINA SIZE/FACILITY CRITERIA

FACILITIES	MARINA BERTH SIZE 250	500	1000
o Yacht Club			o
o Restaurant			o
o Charter House/Harbor Master	o	o	o
o Coast Guard Facility	o	o	o
o Boatside Storage	o	o	o
o Utilities/Services			
Lighting	o	o	o
Power	o	o	o
Phone	o	o	o
Security	o	o	o
Refuse disposal	o	o	o
o Boat Services			
Maintenance	o	o	o
Fixed and Mobile Handling Equipment		o	o
Covered Moorings		o	o
Fueling Station	o	o	o
o Launching Ramps	o	o	o
o Anciliary Facilities			
Water-skiing			o
Swimming			o
Fishing	o	o	o
SCUBA			o
Biking		o	o
Hiking			o
Picnicking			o
Camping			
Outdoor education	o	o	o
o Public House/Community Recreation Center			
Snack bar		o	o
Meeting/Conference Rooms			o
Fishing tackle shop		o	o
Boat rentals	o	o	o
o Transportation			
Parking	o	o	o
Trailer bays			o
Bus/Train stop		o	o
Boat trips/Charter		o	o
Motorcycle/Bicycle sheds			o
o Safety Facilities			
Observation platform			o
Fire-fighting equipment	o	o	o
Life-saving equipment	o	o	o
Warning lights/Navigation lights	o	o	o
Police and lighting	o	o	o
Deicing facilities			o
Weather and tides information	o	o	o
First aid post	o	o	o
o Miscellaneous			
Beaches			o
Paved and grassed areas		o	o
Landscaping		o	o
Swimming bay			o

Local Size

For the local size marina, 250 berths were considered with an additional 150 for moorings and two launch ramps. The total water acreage is 25 and land support acreage is 12 to bring the size to 37 acres. Three boat lengths were considered with their corresponding number of boat slips. For 16 to 25 ft. craft there will be 107 slips, for 26 to 33 ft. craft there will be 76 slips, and for 34 to 42 ft. plus craft there will be 67 slips.

The advantages of this marina size are that its smaller size permits easy maintenance and imposes lesser environmental impacts. However, it may not be large enough to be economically feasible and would not meet the present areas needs. It will also provide only limited services for the region and boat owners.

Intermediate Size

The intermediate size marina will berth 500 craft with an additional 250 moorings. Ten launch lanes are provided with a total land area of 22 acres. Water acreage is 45 which brings the total to 67 acres. For 16 to 25 ft. craft, there are 152 slips, for 26 to 33 ft. craft there are 213 slips and for 34 to 42 ft. plus there are 135 slips.

The advantages are that this size satisfies most local and regional boating needs while providing a good mix of boating services. The only significant disadvantage is the modest harbor size.

TABLE 2 MARINA SIZE/BOAT CAPACITY CRITERIA

MARINA BERTH SIZE			BOAT DOCKING CRITERIA NO. OF SLIPS	SLIP LENGTHS	COMMENTS
LOCAL 250	BERTHS (slips)	250±	107	16'-25'	PRO Small size, easy maintenance Smaller Environmental Impacts
	MOORINGS	150±	76	26'-33'	
	LAUNCH RAMPS	2	67	34'-42'+	
			250		
	WATER ACREAGE	25			CON Not economically feasible Does not meet needs Limited services
	LAND ACREAGE	12			
	TOTAL ACREAGE	37			
INTERMEDIATE 500	BERTHS (slips)	500±	151	16'-25'	PRO Satisfies some local and regional needs Good mix of services
	MOORINGS	250±	214	26'-33'	
	LAUNCH RAMPS	10±	135	34'-42'+	
			500		
	WATER ACREAGE	45			CON Modest harbor size
	LAND ACREAGE	22.5			
	TOTAL	67.5			
REGIONAL 1000	BERTHS (slips)	1000±	269	16'-25'	PRO Satisfies anticipated regional needs and needs for foreseeable future Financially best size
	MOORINGS	500±	426	26'-33'	
	LAUNCH RAMPS	20±	305	34-42'+	
			1000		
	WATER ACREAGE	77.5			CON Increase in traffic Larger Environmental Impacts
	LAND ACREAGE	38			
		115.5			

Regional Size

The regional marina size will berth 1000 craft with 500 additional moorings. Twenty launch lanes are also considered. Total acreage is 115, 77 of which is water and 38 land acres. For 16 to 25 ft. craft there are 269 slips, for 26 to 33 ft. craft there are 426 slips and for 34 to 42 ft. plus there are 305 slips.

The regional marina size satisfies not only the Highland Park community, but also serves the region as well. This is the best size in terms of finances, it is most feasible economically however because of its size, it presents the most environmental impacts and will generate more traffic.

Modifications to Size Criteria

After a number of meetings with local officials and Highland Park residents exploring various aspects of the marina sizes and service mix, a planning decision was made to limit marina facilities to slip mooring only. The principal reason for this decision was economic - to minimize the size of costly protective structures for a large mooring basin. Hence in all three cases discussed above, non-slip mooring has been eliminated to decrease the overall size of the water area acreage required. Some single point mooring still can be considered as a part of normal operations.

Subsequently, the three marina sizes considered for more detailed planning study are:

a. 250 slips, 3 launch ramps. This size marina will be difficult to construct and operate economically, but should be considered for its small scale impact on the area.

b. 500 slips, 2-4 launch ramps. Can be considered as shore attached or island concept; economics still marginal, impact somewhat large.

c. 1000 slips, 4 launch ramps. Considered as island concept only; economics closer to totally self-sustaining. May require marketing evaluation for facility mix.

3.0 Access/Parking

General

Access, which provides for the movement of people and goods to and from the marina, should be built into the existing physical, economic and social character of the Highland Park area. It is important that major access modes and routes be considered well in advance of a marina development so that the various marina and community activities can be successfully integrated.

Development of access routes is generated by future marina needs and represents the anticipated requirements of each area when fully developed for all marina uses and activities proposed.

Discussions of access in this section deal primarily with the general capacity to accommodate anticipated traffic. Impacts of this traffic, along with alternatives, are discussed in the Appendix - Traffic Impact Study.

Access

Unless the marina development considered is unusually large or the existing Highland Park transportation system is significantly undersized, the arrivals and departures of boat

owners and visitors will be characteristically quite dispersed. In light of this, relatively limited access roads could serve the marina activity without undue traffic congestion.

This applies principally to the marina/boating element and if other functions such as shopping, entertainment and conference facilities are to be incorporated, heavier traffic may be generated. However, a review of the proposed marina criteria shows that no such activities are likely to be recommended at this time.

Presently, the site access is provided by Park Avenue and Egandale Road. These two access routes are currently paved roads which parallel the ravines leading to the Park Avenue beach area.

In general, access to a marina has to accommodate a balance between convenience and security. The number of entrances into the marina should be restricted to the minimum, for each will require some access control. It is also important to limit the number of entry points to the slip areas to assist in maintenance of marina visitors control and general security.

Boat owners traditionally want short and easy access routes to their boats, the marina buildings, storage lockers, trailer park and refuse disposal area. Other marina visitors will have entirely different access needs such as boat launching ramps, fishing areas, restaurant use, picnicking and swimming.

Access Route Alternatives Considered

Early during the marina study, seven different access route schemes were developed and analyzed to facilitate the selection of an optimum access route to the marina. These seven schemes explore a diverse combination of alternatives and are discussed in greater detail. Refer to Figures 11 and 12 specific route identification.

Scheme 1 - Park Avenue Access Route

Widen Park Avenue from Park Lane to Egandale to allow two lanes of traffic, one each direction. This scheme would require marina users to use either Central Avenue or Park Avenue to get to the marina site. The proposed widening would infringe on the sensitive ravine area parallel to Park Avenue, as it nears the Park Avenue beach, from Dale Avenue to Egandale Rd.

Scheme 2 - Central Avenue Shuttle

Create a shuttle bus tram route along Central Avenue from St. Johns parking areas to Park Avenue to the marina site. This scheme alone would not accommodate all marina visitors and users but should be considered in addition to one of the other schemes presented here.

Scheme 3 - Central Avenue Access Route

Extend Central Avenue down to the marina site either by traversing the bluff or by means of a funicular where marina users could park above the marina and

ride down. This scheme will involve disturbing sensitive bluff areas and is not recommended for that reason.

Scheme 4 - Laurel Avenue Extension Route

Extend Laurel Avenue down the bluff, running parallel to it, to the marina site. This scheme would involve extensive bluff development and is not recommended for that reason.

Scheme 5 - Prospect Avenue Access Route

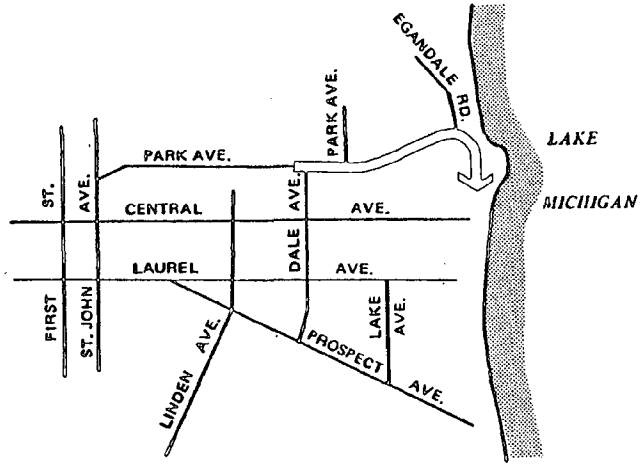
Extend Prospect Avenue down the bluff, parallel to it to the marina site. This scheme would also involve extensive bluff development and is not recommended as an access route.

Scheme 6 - Central Park Parking Lot

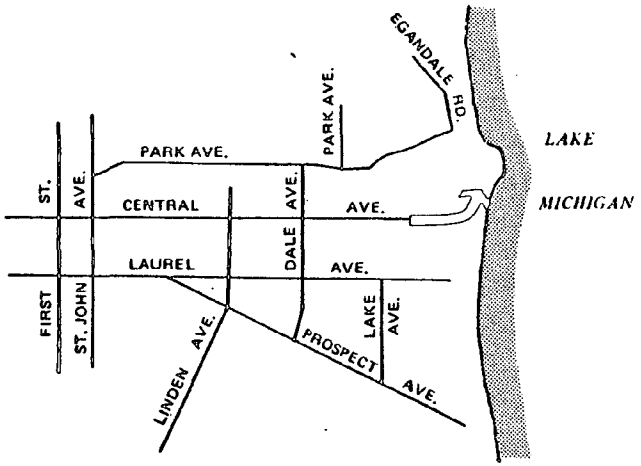
Extend, from Central Park parking lot down to the marina site, a two lane road which would run parallel to the ravine west of Central Park and then proceed to the marina site. This scheme would allow marina users to either park above the site or trailer their boats down to the marina, however regrading of the bluff and ravine development are involved.

Scheme 7 - Central Park Roadway Connection and Park Avenue Widening with Shuttle Bus Connection

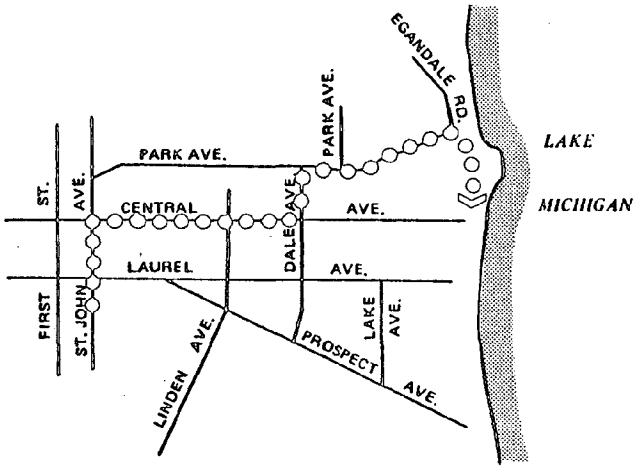
From the Central Park parking area develop a two lane roadway running parallel to the ravine which would connect with Park Avenue. Park Avenue would be widened



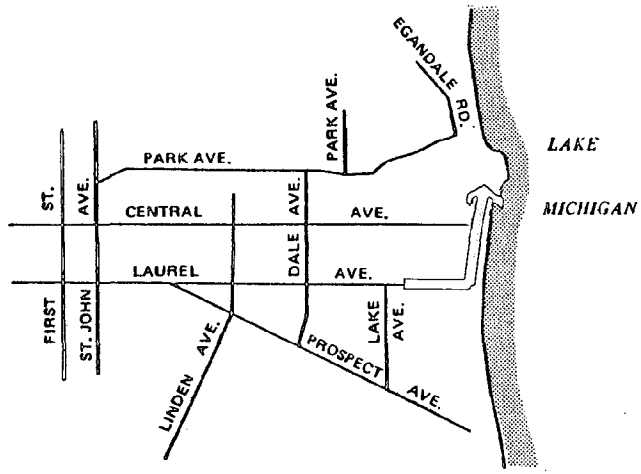
SCHEME 1: PARK AVE. ACCESS



SCHEME 3: CENTRAL AVE. EXTENSION

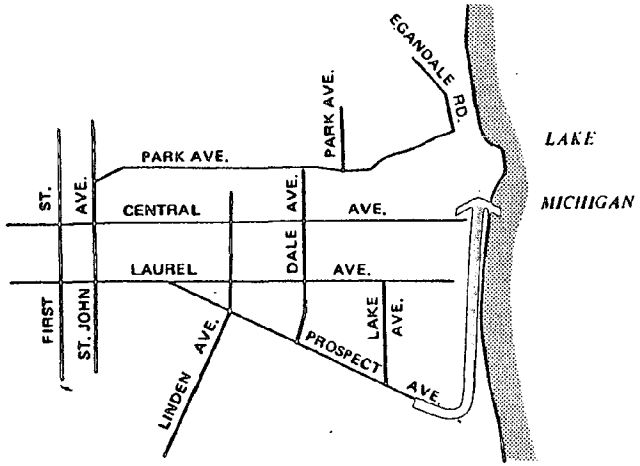


SCEHEME 2: CENTRAL AVE. SHUTTLE/TRAM

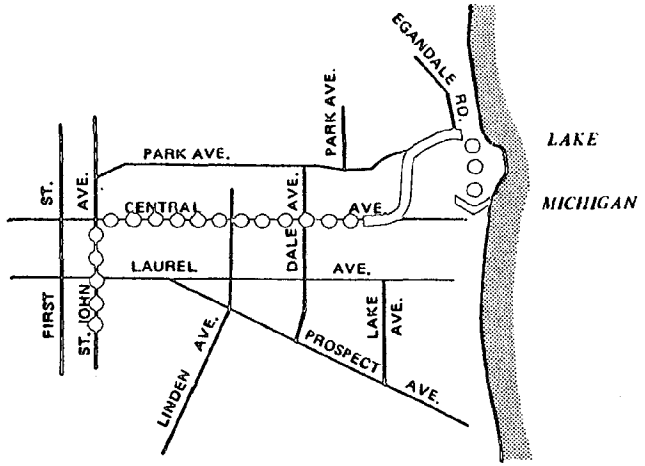


SCHEME 4: LAURAEL AVE. EXTENSION

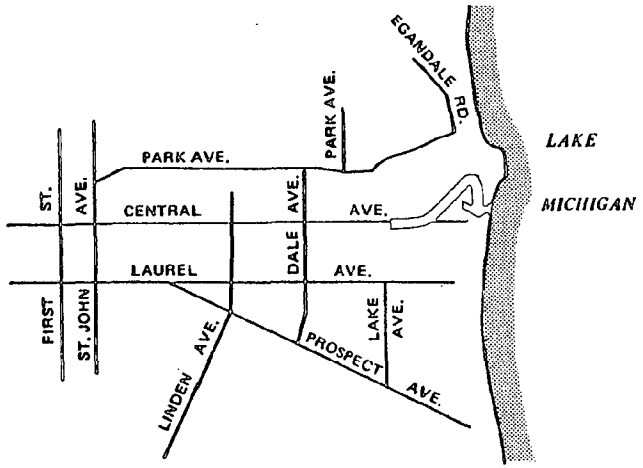
FIGURE 11 ACCESS ALTERNATIVES



SCHEME 5: PROSPECT AVE. EXTENSION



SCHEME 7: CENTRAL AVE. ACCESS, CONNECTION W/PARK AVE., SHUTTLE/TRAM COMBINATION



SCHEME 6: CENTRAL PARK EXTENSION

FIGURE 12 ACCESS ALTERNATIVES

to two lanes from the connection to Egandale Road. In addition, a shuttle bus would be run from downtown Highland Park to the marina along Central Avenue with connecting stops at major selected parking areas. This scheme will allow marina users to either procede directly to the marina with trailered boats, or to park as far away as downtown and still have marina access.

In general, marinas are the most convenient places for boat owners to keep their craft. Boat owners who use marinas feel that good access is an essential element in marina use.

Separation of vehicle types would take place visually before arriving at the marina site by clearly identifying the various entrances for owners, visitors and service vehicles. The proposed schemes allow for this separation by having owners utilize the two lane road as access, and visitors using parking on the bluff or downtown and the connecting train shuttle bus.

Parking

It has been planned to accommodate parking requirements for the proposed marina schemes in the following manner:

a. Boat owners - parking in the marina area
b. Boat trailer/launch ramp users - parking in the marina area
c. Slip owner visitors - downtown commuter parking, using the shuttle bus service to marina
d. Restaurant, shop visitors - parking in the marina area adjacent to corresponding facilities
e. Service functions, employees - parking in the marina area

f. Beach visitors/users/fishermen - parking at top of bluff in Central Park parking lot, downtown and in the marina area

For the type of facility/user mix anticipated for the Highland Park marina, we recommend .75 parking places per each boat slip. These parking accommodations will be provided at the marina site, using the downtown commuter parking lot and the shuttle bus for overflow and peak demand needs. This ratio can be fine-tuned during precise planning of facilities to provide optimum usage for areas allocated for parking. Parking areas should be paved, graded for drainage, lighted and landscaped in such a manner that minimum visual impacts are perceived by surrounding residential areas.

It is anticipated that a fee will be charged to all parking facility users, accommodating parking area fees in slip charges for boat owners and in lease costs for restaurant/shop owners.

4.0 Conformance to Highland Park General Plan

Since the marina concepts developed as part of this study are offshore located, no direct conflict exists with the present city general plan. Beach front property adjacent to the marina has been acquired by the city and is under the jurisdiction of the city's Park District.

The new Highland Park general plan is a goal-guided plan. As such it emphasizes the following goals and means for the lake front usage:

1. To restore the condition of the lake;

2. To restore the eroded beaches;

3. To protect the natural bluffs along the lake front;

4. To create expanded opportunities for fishing, pleasure boating and open air recreation.

Means of accomplishment:

1. Through coordinated regional and local anti-pollution controls;

2. The undertaking of anti-erosion measures;

3. The gradual acquisition of appropriate riparian rights by the City or Park District to create additional beaches;

4. The continuing acquisition of appropriate water-front land as may become available for parks and community grounds.

The feasibility planning for the marina acknowledges these goals, and the selected schemes to a major extent parallel the intent of the city's lakefront development plan.

5.0 U.S. Army Corps of Engineers Planning Criteria

The U.S. Army Corps of Engineers may participate in the

planning and construction of public small-boat harbors and navigation improvements if such projects meet certain established criteria. The Corps performs the necessary studies to ascertain if the proposed project is feasible and warrants funding participation by the Federal government.

Manual EM 1120-2-113 of the Corps of Engineers states the presently acceptable basis for evaluation of benefits from recreational boating and non-commercial or sport fishing, and defines the basis for Federal and local sharing of the costs of navigation improvements for such projects. Generally, the Federal participation in construction is limited to the waterway system of the harbor (breakwaters, jetties, general navigation channels, turning basins, anchorage areas, and bridge modifications). The Federal financial share for the construction of these facilities, according to present policy, is 50 percent for purely recreational facilities. The balance of 50 percent, plus 100 percent of the non-Federal costs of construction, are to be borne by local entities.

When evaluating the financial feasibility of a proposed project, benefits and costs accruing during the life of the project are annualized such that equivalent average annual costs can be compared to equivalent average annual benefits. This is accomplished by identifying various benefits estimated to accrue over the 50-year project life; identifying currently available costs (including amortization and maintenance costs); and applying an interest rate of 6 7/8 percent, the appropriate interest rate currently applicable to public projects of the type proposed. The net effect of converting benefits and costs in this manner is to develop equivalent average annual values.

Comparison of these equivalent average annual charges and benefits is the primary means by which economic justification of a public project is possible. Such a comparison clarifies those proposed projects whose average annual benefits exceed or equal the annual costs of the project, i.e., a benefit/cost ratio greater than unity. Such a condition is preferable if there is to be a Federal contribution toward the project.

If approved for Federal participation, the local entity is generally required to:

a. As indicated earlier, make a cash contribution of 50 percent of the construction costs of the general navigation facilities allocated to recreation and land enhancement, in addition to other requirements of local cooperation;

b. Provide without cost to the United States all lands, easements and rights-of-way for the construction and maintenance of the project when and as required;

c. Hold and save the United States free from damages due to the construction works and maintenance of the project;

d. Provide and maintain without cost to the United States an adequate public landing or wharf and other necessary self-liquidating items;

e. Establish a properly constituted and competent non-profit public body empowered to cooperate

financially and to provide and operate essential local facilities open to all on equal terms;

f. Make such utility and other relocations or alterations as required for project purposes.

6.0 Environmental Considerations

General

To allow for a comprehensive assessment of environmental impacts, the selected site features were examined in light of the proposed project. For the Highland Park region, the following resources and concerns were reviewed and identified:

1. NATURAL PROCESSES
   - o Climate
   - o Ice
   - o Lake Water Levels
   - o Waves and Cur ents
   - o Littoral Processes
   - o Erosion

2. NATURAL FEATURES
   - o Geology/Soils
   - o Bluffs
   - o Ravines
   - o Beach
   - o Lake Bottom

3. MAN-MADE FEATURES
   - o Residential Development
   - o Roads
   - o Erosion Control Structures
   - o Water Intake Structures

4. COMMUNITY RESOURCES

- o Economy
- o Population
- o Aesthetics
- o Recreation
- o Historical/Archaeological/ Paleontological Sites

5. ECOLOGY

- o Vegetation
- o Land Animals
- o Fish, Bottom Organisms
- o Birds
- o Shoreline Ecosystems

6. POLLUTION CONCERNS

- o Air
- o Land
- o Noise
- o Visual
- o Water

The Highland Park area includes a variety of interesting and valuable landscapes. The near-shore region is typical of the undisturbed Lake Michigan shoreline, with a narrow beach backed by high bluffs. As observed in many locations along this shore, the bluffs are actively eroding in spite of shore protection measures along Highland Park beaches. Reaching nearly 100 feet above mean lake level, the bluffs afford Highland Park riparian residents pleasing vistas. Other notable natural features of the landscape include ravines which cut through the bluffs at several locations, the narrow, rubble-strewn beach, and the recreation-oriented waters of Lake Michigan.

Man-made features of interest include the several bluff top residential units, Highland Park's municipal water treatment facility, many shore protection structures, and the submerged water intake structures extending into the lake.

Figure 13 shows a schematic cross-section representation of ten environmentally sensitive areas in the vicinity of the project. Each identified item in the shoreline cross-section has some vulnerability to activities and impacts associated with the proposed project.

Potential Impacts and Mitigation Measures

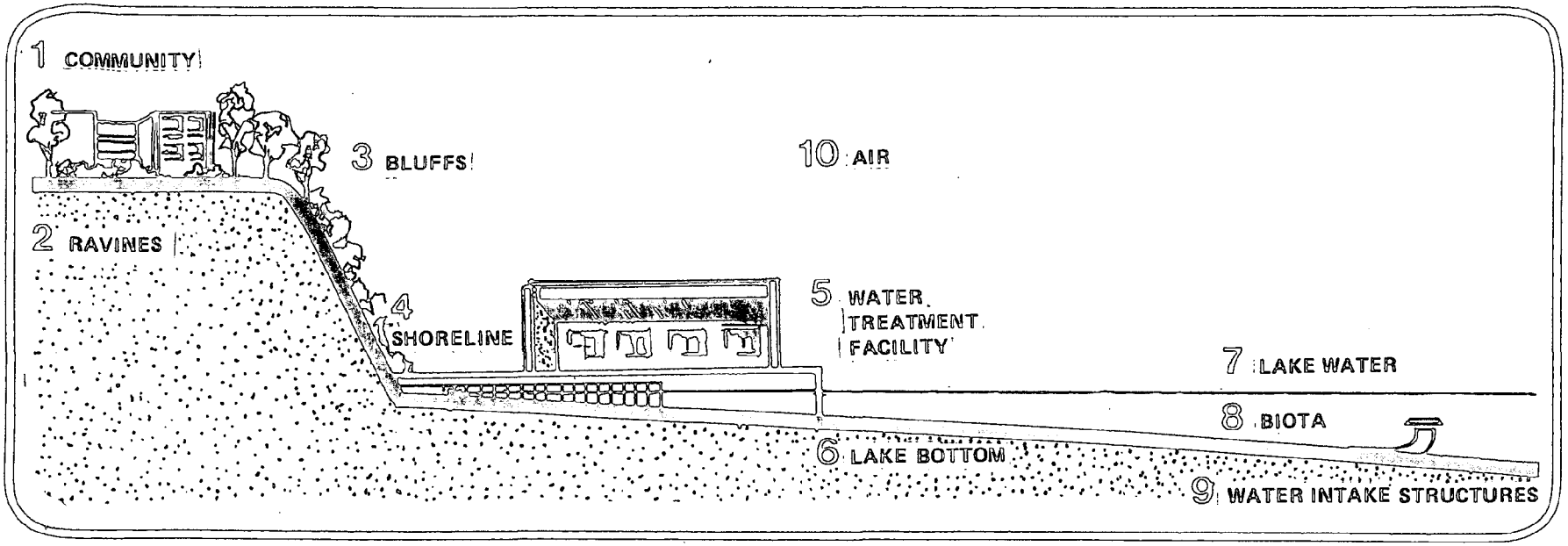
Proposed offshore marina schemes are described in detail in other sections of this study, principally to allow evaluation of structural and economic feasibility. Such details also permit an environmental review, supporting significantly, the subsequent planning process and identification of mitigation measures. Mitigation actions can reduce and, in many cases, eliminate adverse impacts associated with a project, particularly if recognized and incorporated early in the design process. The following discusses the major potential impacts of marina construction, operation, and maintenance and presents some of the principal mitigation measures for further consideration.

Construction activities that would impact the environment include:

1. CAUSEWAY CONSTRUCTION - Connecting marina with shore, elevated on pilons.

2. EXCAVATION - Submarine construction work for breakwater structures.

3. BREAKWATER CONSTRUCTION - Using rock of various sizes to build the wave protection structures.



1. Community - commercial, residential, and service districts; sensitive to population flux, economic activity, traffic increase.

2. Ravines - natural features, sensitive to erosion, construction activities.

3. Bluffs - 100 ft. high natural features providing residential, scenic, and aesthetic value; sensitive to construction, groundwater seepage, erosion.

4. Shoreline - narrow beach protects bluff; limited recreational use due to groins, debris; sensitive to erosion, water quality degradation, noise.

5. Water Treatment Facility - water supply for Highland Park; necessary city function; sensitive to removal.

6. Lake Bottom - fine sand supporting various flora and fauna; sensitive to construction and water quality degradation.

7. Lake Water - provides recreational, aesthetic, habitat value and city water; sensitive to water quality degradation.

8. Biota - sport fish and rare & endangered species; sensitive to water quality degradation, habitat destruction.

9. Water Intake Structures - collect municipal water for treatment; sensitive to construction.

10. Air - essentially clean with common breezes from NE and SE; sensitive to emissions.

FIGURE 13 ENVIRONMENTALLY SENSITIVE AREAS

4. ISLAND CONSTRUCTION - Fill material encased by breakwater structures and steel sheet piling.

5. FACILITY CONSTRUCTION - Restaurants, chandlery, fuel dock, yacht club, administration, and parking lots.

Above outlined activities represent the major impacts of marina construction. Additional impacts are associated with the long term existence and operation of the marina, and include:

1. PHYSICAL PRESENCE OF THE STRUCTURE - The alteration of the earth's surface with a structure and materials that will resist erosion. Impacts from this aspect, such as the alteration of water circulation patterns, are distinguished from those resulting from use of the harbor.

2. HARBOR UTILIZATION - Its use by boating public, fishermen, tourists, and sightseers and their accompanying impacting factors, such as fuel and oil spills, noise, safety requirements, vehicle and vessel traffic.

3. HARBOR MAINTENANCE - A sand by-passing system, oil spill cleanup operations (as required), facility and landscape maintenance.

The impacts associated with construction, existence, and maintenance of the marina have been tentatively identified. Ten of the potential impacts are presented in Table 3. Each impact is rated as to the probability of occurrence should the project be implemented, the impact's magnitude

(i.e., degree, extensiveness, scale), and the importance (i.e., significance, value). A discussion of Table 3 follows:

1. EROSION - Any structure in the nearshore zone that interrupts the natural wave climate and littoral flow of sand will result in shoreline changes. As compensation, the littoral processes will redistribute nearshore material as equilibrium is sought, usually resulting in areas of accretion and erosion. With the T-configuration Marina Scheme, a large portion of Highland Park shoreline will experience accretion, generally equivalent to 1.5 times the length of the marina. Accretion would probably extend from the Park Avenue area at the northernmost limit to the vicinity of the abandoned treatment plant at Ravine Drive. Littoral material will be impounded over several years, gradually forming a sandy beach covering the existing groins, providing new recreational areas, and protecting the valuable bluffs in this area. Erosion attributable to the proposed marina will most likely occur south of Ravine Drive, extending 2 to 3 miles farther south. Due to the existence of many protective structures in this region, the beach and bluffs are not likely to be affected. The demand for material will be shifted lakeward somewhat, resulting in some scouring around exiting groins, seawalls, and revetments. The underwater profiles will steepen to reflect this loss of sand.

   Mitigation of marina-induced erosion is straightforward: trucking material from the accretion area to the erosion area. This mechanical movement of

TABLE 3 POTENTIAL ENVIRONMENTAL IMPACTS

IMPACT	Probability of Occurrence*	Magnitude*	Importance
1. Erosion	High	High	High
2. Water Quality	High	Moderate	High
3. Community Character	High	Moderate	High
4. Visual	High	Moderate	Moderate
5. Noise	High	Moderate	Moderate
6. Fish	High	Low	Moderate
7. Benthos	High	Low	Low
8. Air Quality	Moderate	Low	Low
9. Cultural Resources	Low	Low	Low
10. Existing Recreation	Low	Low	Low

*Without mitigating measures

sand is an essential part of the proposed marina plan, and should be accomplished annually to minimize downdrift erosion. Trucks and front-end loaders will be required to collect material from the newly formed beach near Central Avenue and transport it to the needy area, probably the Ravine Beach vicinity.

2. WATER QUALITY - Impacts to water quality are expected during construction, operation, and maintenance of the proposed marina. Turbidity will be increased during breakwater and island construction due to the disturbance of the lake bottom. Water quality within the marina, once it is operational, will be affected by engine exhaust, vessel maintenance, and storm water drainage. Bacterial contamination of harbor waters may result from accidental solid and human wastes discharged from vessels within the marina. The use of inboard and outboard marine engines for vessel maneuvering within the harbor will result in emissions of carbon monoxide, carbon dioxide and hydrocarbons. Lead-containing fuels and engine oils will be released to the aquatic system, resulting in secondary impacts to lake biota, recreational beaches, and the municipal water supply. Surface runoff from the newly formed island--particularly from the parking area could further degrade the marina's waters with greases, oils, and particulates.

The buildup of these pollutants, however, is unlikely due to the excellent flushing characteristics of the proposed marina scheme. Water circulation will be good--particularly in the west basin and

in the vicinity of the fuel dock. Surface water currents of Highland Park's nearshore region are variable but generally correspond to the predominant wind direction. Pollutants are likely to be carried shoreward where they may collect on beach sand through the process of adsorption. With winds from the southeast, marina pollutants have the potential for entering the city's water intake structures; the severity and number of such episodes expected annually cannot be determined at this time.

A number of mitigating actions can be taken to reduce impacts to water quality resulting from the marina operations. Regulations against vessel waste discharge within a marina and within 10 nautical miles of the harbor entrance are commonly applied at other Illinois harbors and would virtually eliminate water quality problems from these sources. Prevention or at least isolation of vessel maintenance practices (scraping, sanding, painting) and attendant wastes would limit water quality degradation from maintenance.

Directing surface runoff waters into existing sewer lines or at least outside the marina would reduce the amount of grease, oils and particulates expected. A most important mitigation factor is the careful modeling of marina designs to identify the optimum internal circulation and flushing characteristics of the selected plan. Investigations should include quantitative studies of the fate of marina pollutants in Lake Michigan--if they collect in beach sands, affect municipal water

quality, or are incorporated into the biota. The probability of impacting the area's water quality could be high, but with the implementation of the suggested mitigation measures, the magnitude will be moderate. The existence of municipal water intake structures in the vicinity of the proposed marina make water quality impact considerations highly important.

3. IMPACTS ON COMMUNITY CHARACTER - The presence of a recreational harbor in a community within an hour's drive of a major metropolitan area will draw sport fishermen, boat owners, tourist-related businesses, marine equipment dealers, and attendant services. The activity level will generally increase--with some increase in daily and weekend traffic; community services will require some expansion and businesses will enjoy increased patronage. Holiday weekends will generate increased marina traffic. Generally, Highland Park will become more visitor oriented, as families from the surrounding communities will travel to enjoy the benefits of the marina.

   The increase in overall community activities in Highland Park after marina construction cannot be avoided. There is a distinct probability of some specific impacts to the community character from the proposed marina. The impact, in the form of increased activity, will be moderate in magnitude. In view of Highland Park's goals to maintain a small-town atmosphere, the importance of this type of impact is considered high.

4. VISUAL IMPACTS - Most stages of marina construction

and operation will result in visual impacts. Barges, cranes, trucks, bulldozers, front-end loaders, and graders will be required for construction, some of which will be in daily use throughout the two-year construction period. The existence of the harbor itself will alter the lakeward vista, as will the vessels using it. Whether this visual impact is positive or negative depends a great deal upon the final design of the facility and is subject to a number of mitigation measures. Architectural and site planning efforts may be combined with careful landscaping to create an aesthetically pleasing structure. Generally speaking, visual impacts of moderate magnitude and importance are expected.

5. NOISE IMPACT - As with the visual impacts, noise is expected during marina construction, operation and maintenance. Noise affects shoreline serenity, which is one of the benefits of lakeside living.

   To minimize these impacts, the land detached island concept marina has been considered, which will remove much of the potential direct noise impacts from the residential areas on the bluff. The distance of separation between land and marina is significant enough to minimize most marina generated noise impacts.

   Specific sources of noise will be vehicular and vessel traffic. For example, with four launching ramps the marina has the capacity of accommodating over 120 launches of trailerable craft each day. With vessels returning to the ramps the same day,

the basin within 100 yards of the newly created recreational beach, could experience up to 240 small craft passages on a peak day. However, considering the attenuation of sound with distance, only a localized area will be affected. At this time, only a moderate noise impact is expected.

6. IMPACTS ON FISH - A variety of Lake Michigan fish inhabit the nearshore region for spawning and larval development. Families represented by such species include sucker, sculpin, stickleback, smelt, perch, trout perch, and herring. Rare and endangered fish species collected or observed along the Lake County waters of Lake Michigan include the cisco and the eastern longnose sucker (a rare species of amphibian, the blue-spotted salamander, also inhabits Highland Park beaches).[1] Construction and maintenance dredging, if conducted during spawning times, could result in the destruction of eggs and larvae, and will alter the benthic habitat used for hatching. The size of the area involved, however, is small when compared with the many miles of nearshore environment of Lake Michigan. Though there is nothing unique about the proposed marina location, construction of facilities will prevent the use of the area for fish spawning which may become increasingly important as Lake Michigan's nearshore regions are gradually consumed.

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[1] Rare and Endangered Vertebrates of Illinois, Bureau of Environmental Science, Illinois Department of Transportation, June, 1977

Mitigation of impacts to fish populations include limiting construction in nearshore waters to those months of minimal spawning activity--usually in early spring. Water quality impact mitigation would, in turn, benefit local fish. Assuming these actions will be implemented, an impact of low magnitude and moderate importance is expected.

7. IMPACTS ON BENTHOS - Lake bottom organisms will be destroyed during construction and periodically during maintenance dredging. The magnitude of impact will be low due to two factors: (1) the marina will be generally located in waters shallower than 25 feet, in which very few species and low densities of benthos exists. The total area expected to be covered by breakwater structures and the proposed island is about 45 acres. This is a small fraction of the millions of acres within Illinois' jurisdiction of Lake Michigan. Benthic fauna have a significant place in the food chain and are included in the diet of many fish species. The importance of benthos impact is low because they have no commercial value and they usually recover rapidly when disturbed.

   An impact mitigating factor is inherent in the proposed marina plans: using rough-hewn granite for breakwater construction. As a newly introduced substrate, the granite allows for a much more diverse and productive benthic community than that which currently exists in the area.

8. AIR QUALITY IMPACTS - Air emissions associated with internal combustion engines are expected from construction equipment, automobiles, and vessels. Such emissions typically include photo reactive hydrocarbons, carbon monoxide, oxides of nitrogen, and particulates. The number of vehicles and vessels operating for extended periods in the area will be small, with a majority of activity on weekends and holidays. Considering the ambient winds and turbulence in this region, the magnitude and importance of air quality impacts will be low.

9. IMPACTS ON CULTURAL RESOURCES - Submerged archaeological and paleontological sites of significant value have been discovered within the nearshore region of Lake Michigan. The probability of encountering such a site during marina construction at Highland Park is very low. Certain procedural steps should be taken to mitigate the magnitude of impact to such resources should a site be found. These steps are required by law and would result in an impact of low magnitude. The potential for paleontological resource existence in the project area warrants further review.

10. IMPACTS ON EXISTING RECREATION - Current recreational uses of the Highland Park shoreline will be minimally impacted by the proposed marina. Construction activity will cause some noise and disturbance to the detriment of recreational bathers and shoreline strollers (depending on the time of year). Sport fishermen may lose a favorite fishing location or notice that fish avoid the construction

zone. However, there is a low probability an adverse recreation impact will occur at all, and if so it will be of low magnitude and importance.

The benefits of the proposed marina on community recreation are obvious: increased boating convenience and opportunity for sport fishing. In addition to providing shore protection the marina will result in an improved recreational beach for swimming, paddle-boarding, small boat sailing, and will provide an all-year community facility resource to be used for a wide cross-section of civic and cultural activities.

7.0 Aesthetic/Visual Considerations

As a significant consideration in development of a project of this scope, the visual/aesthetic impact warrants careful scrutiny. In general, marina developments are considered positive visual impacts - boats, sails and other harbor/marina related equipment and structures have a certain visual quality considered desirable by a large number of visitors and users.

However, it is possible that insensitive design, development and operation of a harbor can create a visual environment less desirable than anticipated. The difference usually can be found in the manner in which the overall approach to design and control of the visual environment is undertaken. The most successful projects of this type incorporate the

following general design concepts:

a. All major design elements (structures, buildings, landscaping) are integrated and design work is undertaken in a coordinated manner.

b. All structure color, texture, material and key design feature selection is coordinated, using a preselected design vocabulary.

c. Signage is made to be an integral part of the design development and parallels the design vocabulary.

d. Landscaping softscape and hardscape is developed with long term goals and maintenance in mind, and is made to function as an integral part of the overall visual environment through all seasons.

e. The planned maintenance program is structured and budgeted to maintain the overall visual quality standards set during the design of the harbor. All tenant site areas should meet the same criteria.

f. A design standard committee is established to oversee and approve major changes and additions to the harbor/marina.

Architectural Vocabulary

Although it is not within the scope of this feasibility analysis to develop a precise architectural vocabulary for the proposed structures in the marina, a general set of

guidelines are proposed and illustrated in a schematic form in a 1"=100' scale model.

The following broad guidelines are proposed for structure design:

1. Materials, surface textures and color schemes used in design elements should be indigenous to the region and in harmony with the predominant area architecture. Textures and colors should be natural to the extent possible-taking advantage of earth related tones, stone, concrete, clays, natural wood and unprotected steel (Cor-ten) visual properties.

2. Structure shapes/design forms should incorporate principles of sound environmental design providing shelter from the environment in the most effective manner. Considerations should include:

    a. Protection from predominant lake winds.

    b. Snow/ice shedding sloped roofs.

    c. Energy conserving - clustered rather than expanded.

    d. Shelter from wind and rain for users moving between structures, where possible.

    e. Raised pad construction to resist occasional breakwater overtopping during severe storms.

f. Landscaping hardscape and softscape to be integral with structure design, providing shelter in moderately severe weather.

8.0 Water Plant Expansion Requirements

As part of this feasibility analysis, consideration has to be given to the potential expansion requirements for the city's water intake/filtration plant, located directly north of the proposed marina site area.

Its current capacity is adequate to handle the existing Highland Park requirements, but as population and commercial growth increases and additional demands for water continue to grow, space for additional plant capacity will have to be made. Several alternatives were considered:

a. Expanding the plant directly south and/or north of the existing building. This concept conflicts with marina access requirements.

b. Expanding the plant in a westerly direction, cutting into the bluff slope. This scheme tends to cut off the proposed marina access route and destroys existing vegetation on the bluff.

c. Expanding the water works by double decking the plant, i.e., building the expansion increment on top of the existing facility. This accommodation scheme would be quite costly, disruptive to existing water intake/filtration activities and would create a visually massive structure obstructing lake view for a number of riparian owners.

d. Expanding the water works facility by building a separate intake plant increment on the existing parking property north of the plant. This approach would allow for uninterrupted operation of the existing plant during construction, would place intake conduits in the proper location in relation to the proposed marina and its traffic, and generally would be the least costly mode to accommodate increased water demand capacity.

The presented marina Scheme 6-1000 considers this last expansion alternative as the one the city should pursue when the marina project is implemented.

ALTERNATIVE PLAN DEVELOPMENT

E. ALTERNATIVE PLAN DEVELOPMENT

1.0 General Discussion

The Highland Park site location, configuration and physical access constraints impose a number of planning restrictions on the development schemes for the marina. Figures 20, 21 and 22 identify the ownership boundaries, topography, bathimetry and locational conditions for the site area. Vehicular access to the site and offsite parking is discussed in Section D.

Principal physical site constraints are:

1. Limited site access (discussed separately in Section D).

2. Narrow sandy (20'-40') beach bordered on the west by 60' to 75' bluff. Bluff face covered with vegetation in different stages of damage.

3. Sheet pile groins, perpendicular to shore, extending the entire width of the site, currently blocking pedestrian beach passage.

4. Location of the city's water intake and treatment plant, straddling the site area on the northerly side of the property. Requirement exists for subsequent future expansion of the facility, to be accommodated at this general location.

5. Raw water intake lines (18", 20" and 30" diameter) and intake structures located offshore approximately in line with the water treatment facility. Remnants of abandoned intake lines located directly south of the active ones.

6. Underground sewer main parallel to beach at toe of bluff.

Because of these constraints two principal marina/harbor planning concepts were considered:

a. Shore attached, with land fill pad, reaching into the lake to minimize extent of shore contact.

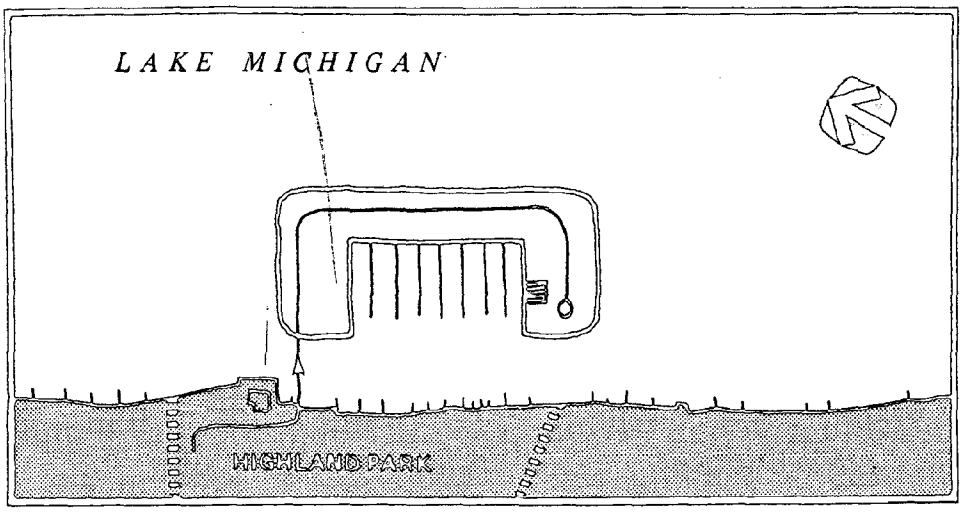
b. Detached, island land fill pad, connected to shore by elevated causeway.

A total of eight general configurations, fitting the above concepts, were considered initially. Two were discarded early, with some of their features incorporated in subsequent schemes. Figures 14 and 15 show the six configurations developed for further consideration.

Scheme 1-500, 500 slip, island concept developed as the very first scheme, was subsequently discarded because of potentially high construction cost (extent of fill); need to be constructed high enough above mean high water level to protect landside structures.

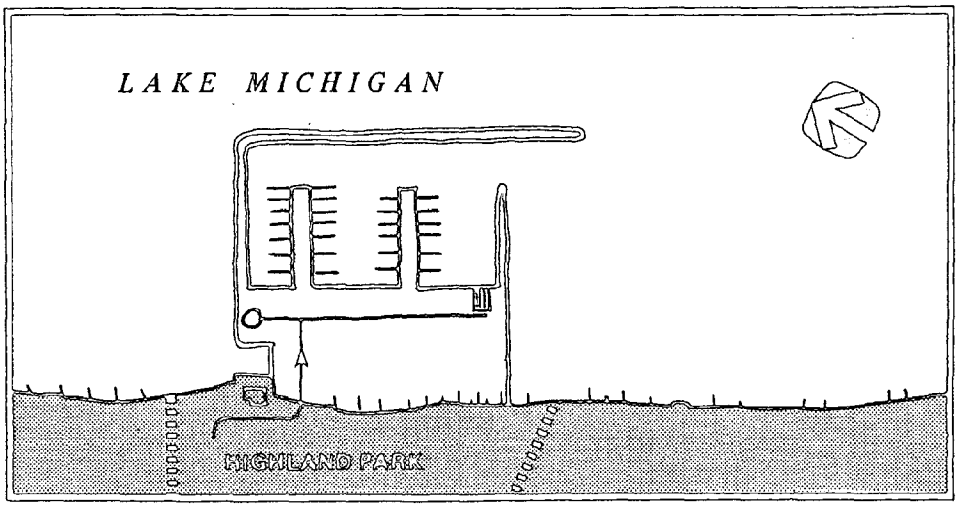
Scheme 2-500, 500 slip, shore attached land fill pad concept was retained for further analysis. It appears to have enough potential for detailed cost evaluation and feasibility assessment. This scheme requires sand by-passing, adding to the annual operative and maintenance costs.

Scheme 3-500, 500 slip, shore attached--detached breakwater concept was discarded due to potentially high maintenance costs.



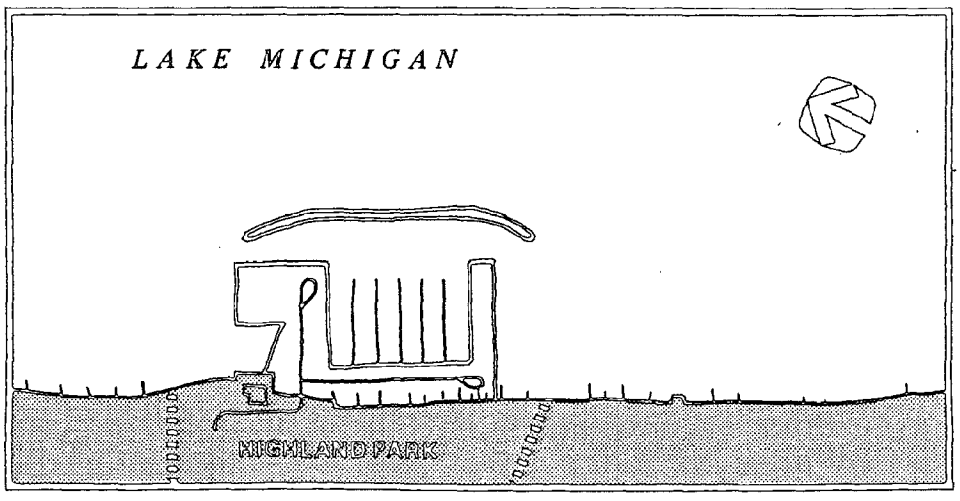
ISLAND CONCEPT
500 SLIPS

SCHEME
1 – 500



SHORE ATTACHED
500 SLIPS

SCHEME
2 – 500



SHORE ATTACHED
500 SLIPS

SCHEME
3 – 500

FIGURE 14 MARINA CONCEPTS CONSIDERED

Scheme 4-1000, 1000 slip, detached island concept. This configuration has good potential and was retained for further analysis. Principal advantage--good service mix for high annual revenue.

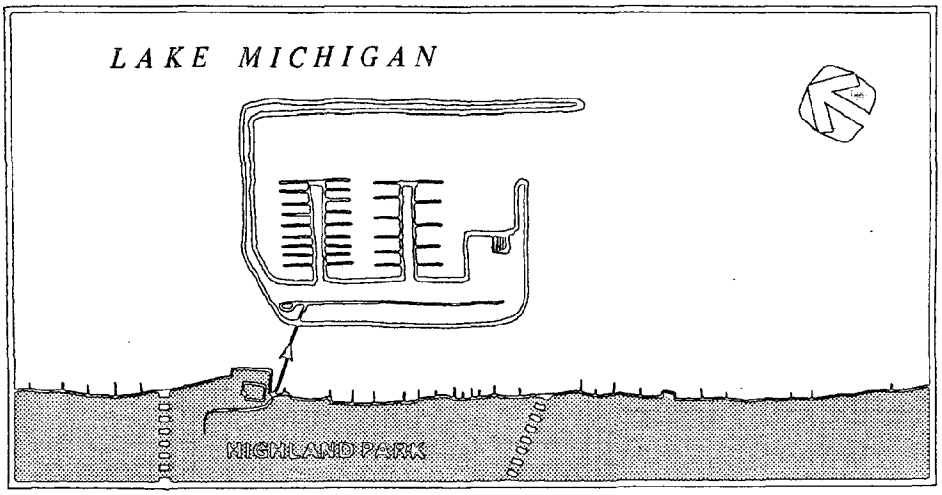
Scheme 5-500, 500 slip, detached island concept, although reasonably acceptable from a functional point of view, was discarded in favor of same configuration with 1000 slips.

Scheme 6-1000, 1000 slip, detached island concept has benefits warranting further analysis, major drawback is large perimeter of center mole and long wave shadow on beach.

Schemes 2-500, 4-1000 and 6-1000 were subsequently further developed to planning scale (1"=100') and detailed schematically for cost comparison. Facilities identified in the initial criteria section were facilitated in each plan.

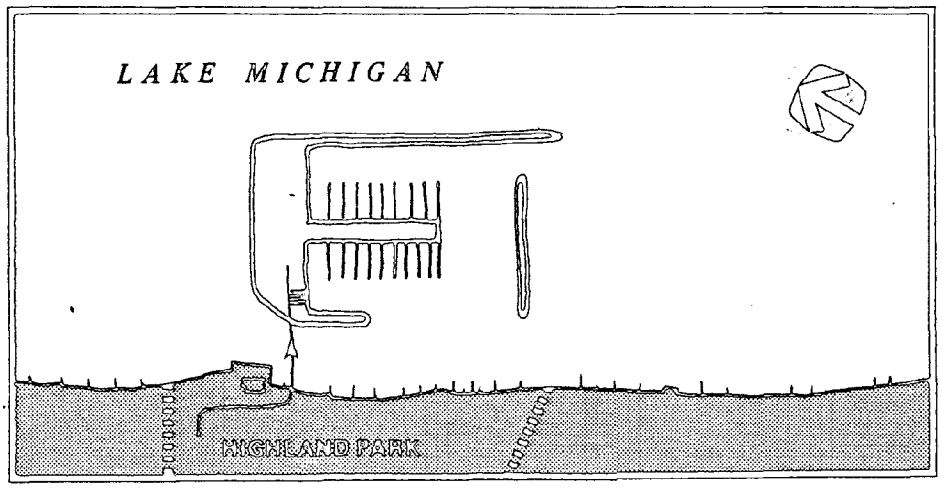
Because of the anticipated high cost of offshore construction of protective structures and island fill, it was considered that marina concepts will be developed for slip utilization only. Moorings generally require more space and therefore would not be contributing to a positive benefit/cost ratio for the selected concepts.

Each of the above design schemes was developed to minimize construction costs, major environmental impacts such as interference with coastal processes and loss of sand; and optimize operational and maintenance advantages. Another major consideration was visual and physical separation from beachfront properties adjacent to the city owned land, interference with major view lines towards the lake and providing separation from the water intake lines and structures.



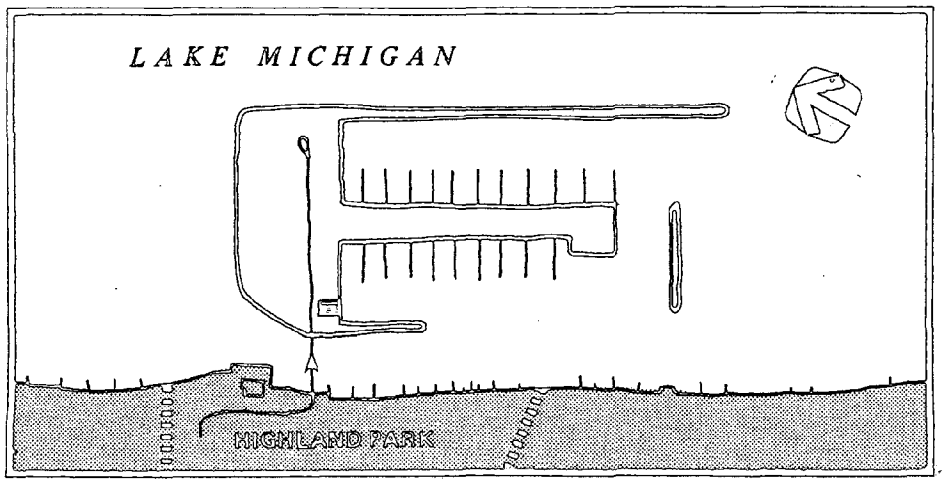
ISLAND CONCEPT
1000 SLIPS

SCHEME
4 – 1000



ISLAND CONCEPT
500 SLIPS

SCHEME
5 – 500



ISLAND CONCEPT
1000 SLIPS

SCHEME
6 – 1000

FIGURE 15 MARINA CONCEPTS CONSIDERED

2.0 Protective Structures

In the initial stages of the planning process, concrete caissons, steel sheet pile cells, and rubble mound using both quarried rock and precast concrete armor units were considered as possible methods of breakwater construction. Subsequent discussions with the U.S. Army Corps of Engineers' Chicago District, however, indicated that rubble mound using natural rock has consistently proven to be the most economical means of construction along the Illinois coast. In consequence, all protective works for the alternative marina plans discussed below are designed as rubble mound structures.

As indicated in the Illinois Coastal Zone Management Project's Hydrography Compilation Map, Figure 10, the dominant sediment constituents in the project area are fine and very fine sand. The bottom material thus appears to present no unusual construction problems. A comprehensive solid survey should be performed before detailed design is undertaken to determine if lenses of unstable material such as clay occur, requiring removal prior to breakwater construction.

The following design water levels are selected for project design:

Design Low Water (DLW) = 576.8' IGLD or 0.0' Low Water Datum (LWD)

Design High Water (DHW) = 581.1'IGLD or 4.3' Low Water Datum

Range = 4.3'

The selected design high water level, which represents the 10-year event as predicted by the U.S. Army Corps of Engineers' Detroit District, includes the effects of both short and long period lake level fluctuations. It should be noted that the design high water level also corresponds to the datum of soundings used on the Illinois Coastal Zone Management Project's Hydrography Compilation Map for the project area.

Based on the available information on wave climate in the project vicinity, Section C.2.0 - Waves, the following waves are selected as a basis for the design of protective structures:

Northerly and Easterly Exposure

Deepwater Approach Direction:	Northeast
Deepwater Significant Height:	12.0 ft.
Significant Period:	8.0 sec.
Significant Height at Marina Site: (considering effects of refraction)	12.0 ft.

Southerly Exposure

Deepwater Approach Direction	East Southeast
Deepwater Significant Height:	9.75 ft.
Significant Period:	6.7 sec.
Significant Height at Marina Site: (considering effects of refraction)	8.0 ft.

Most breakwaters and revetments for the various marina schemes are designed with a side slope of 1 on 2. As verified by the Chicago District of the Corps of Engineers,

quarrystone with a unit weight of 165 pounds per cubic foot is available for the project area, and is, therefore, used as the basis for all volume and cost estimates. For purposes of economy, protective structure elevations are designed to permit moderate overtopping by the design wave under design high water level conditions. In the case of the artificial island schemes, buildings will be protected from damage due to revetment overtopping by raising the finish floor elevations a minimum of two feet above the filled area.

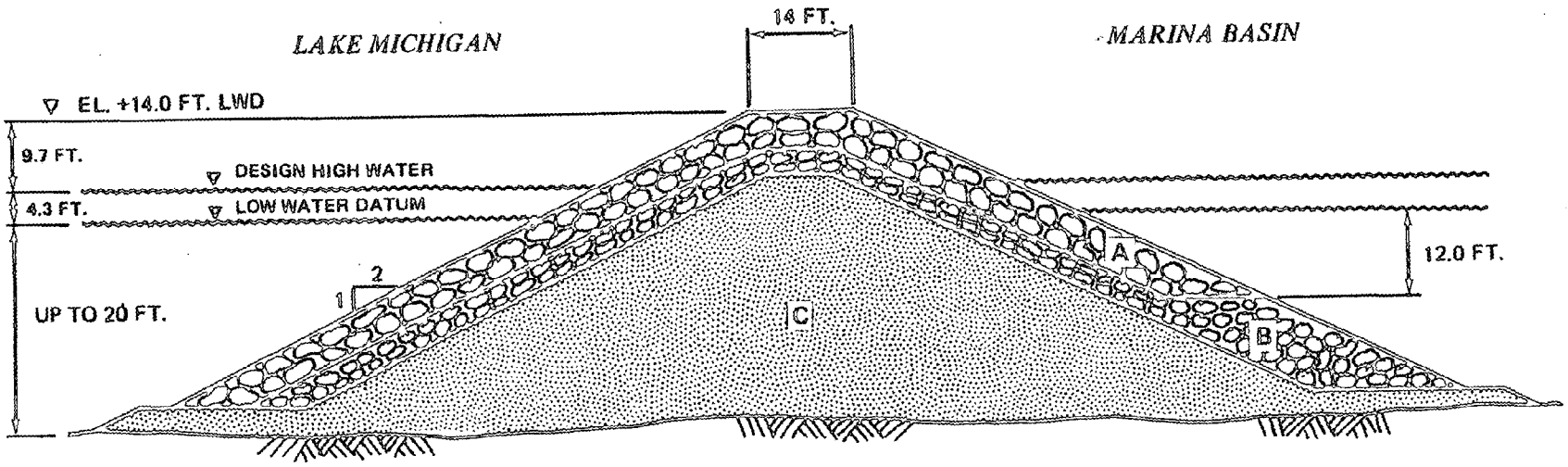
Breakwater sections typical of all three marina schemes are depicted in Figures 16 and 17 , with Section A-A in Figure 16 designed for a northerly and easterly exposure and Section B-B in Figure 17 designed for a southerly exposure. Section C-C in Figure 18 represents a section through the artificial island Scheme 4-1000; the cross-section for the island Scheme 6-1000 is similar although not identical.

As an example of the procedure followed in the design of breakwaters and revetments, the design calculations for the easterly breakwater of Scheme 4-1000 are included in Appendix.

3.0 Entrance and Basin

Two criteria are applied to determine the required depth of the marina basin entrance channel:

1. The channel must provide underkeel clearance for the design vessel (assumed to have a draft of 8.0 ft.) subjected to design wave conditions at Design



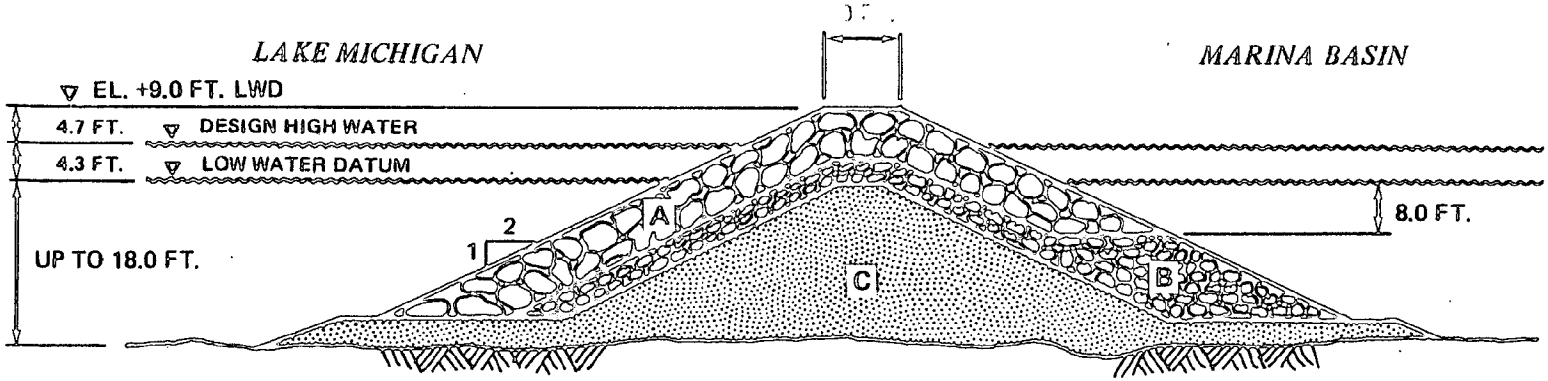
A = ARMOR:W = 5 TONS
B = UNDERLAYER W = 1000 #
C = CORE: QUARRY RUN

NOT TO SCALE

SECTION A – A

NOTE: SECTION A – A IS TYPICAL OF ALL MARINA SCHEMES

FIGURE 16 BREAKWATER SECTION A–A



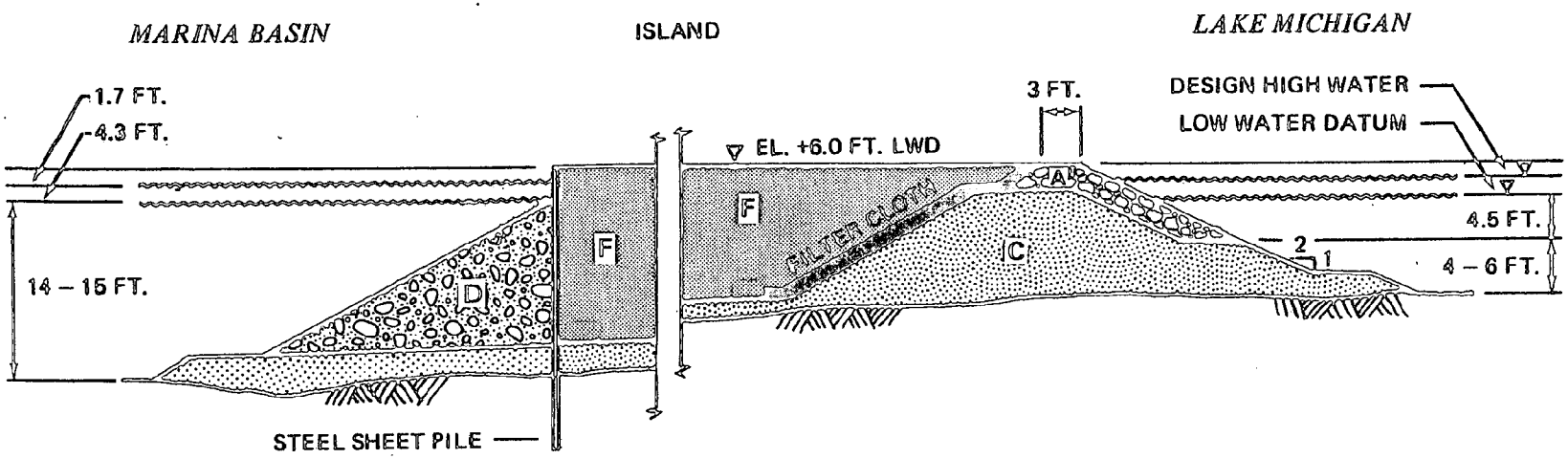
A = ARMOR: W = 2 TONS
B = UNDERLAYER: W = 400#
C = CORE: QUARRY RUN

NOT TO SCALE

SECTION B – B

NOTE: SECTION B – B IS TYPICAL OF ALL MARINA SCHEMES

FIGURE 17 BREAKWATER SECTION B–B



A = ARMOR: W = 200*

C = CORE: QUARRY RUN

D = WAVE ABSORBING RUBBLE

F = FILL

NOT TO SCALE

SECTION C – C

NOTE: SECTION C – C APPLIES TO SCHEME 4 – 1000

FIGURE 18 ISLAND CROSSECTION C–C

Low Water.

2. To the extent economically possible, the channel must be free of breaking waves.

In consideration of these requirements, an entrance channel open to the south southeast (protected from the most severe wave conditions anticipated) with a minimum depth of approximately 16 ft. at Design Low Water is proposed in all schemes. A clear channel width of approximately 300 ft. is provided. This dimension fulfills the requirements of tacking sailboats as well as power craft.

A controlling depth of 10 ft. at Design Low Water is considered for those areas of the marina basin devoted to berthing of larger craft. This depth offers adequate underkeel clearance for the design vessel with a draft of 8 ft. In all three marina schemes under consideration, the requisite entrance and basin depths are obtained without the need for dredging.

Because of the refractive and diffractive dissipation which occurs as waves approach and enter the marina basin, wave heights at the berthing areas for all three schemes are anticipated to be approximately 1.0 to 1.5 ft. under design wave conditions. Final design of the selected configuration should be proceeded by model tests, however, to ensure that wave heights throughout the basin do not exceed this acceptable level.

4.0 Economic Analysis

This preliminary economic analysis deals with the general viability of the 500 and 1000 slip proposals - 2-500 and 4-1000. Further economic evaluation for the final selected scheme is in Section G, Selected Plan 6-1000 Analysis.

A preliminary economic analysis of the alternate plans under consideration was made to establish their viability from two perspectives:

1. That of the U.S. Army Corps of Engineers utilizing the accepted criteria for justifying Federal participation in construction funding.

2. That of the local bodies charged with operating the facilities and servicing the debt thereon.

These analyses were based upon conceptual planning and cost data, an estimate of market rents developed from a general survey of marinas in the area, and certain assumed market data. As project definition continues and a selection of the final marina configuration is made, the cost and market factors will be more closely identified through more in-depth studies of the area.

Federal Funding

It is the purpose of the federal criteria to define both the benefits and costs of a proposed project in order to ascertain its justification for federal funding. The U.S. Army Corps of Engineers performs the necessary feasibility studies and, if the project meets the criteria, assists

in the construction of small boat harbors and other navigation improvements.

Manual EM 1120-2-113 of the Corps of Engineers states the presently acceptable basis for evaluation of benefits from recreational boating and non-commercial or sport fishing, and defines the basis for Federal and local sharing of the costs of navigation improvements for such projects.

Benefits and costs accruing during the life of the project are annualized such that equivalent average annual costs can be compared to equivalent average annual benefits. This is accomplished by identifying various benefits estimated to accrue over the 50-year project life; identifying currently available costs (including amortization and maintenance costs); and applying an interest rate of 6-7/8 percent, the appropriate interest rate currently applicable to public projects of the type proposed. The net effect of converting benefits and costs in this manner is to develop equivalent average annual values.

Comparison of these equivalent average annual charges and benefits is the primary means by which economic/justification of a public project is possible. Such a comparison qualifies those proposed projects whose average annual benefits exceed or equal the annual costs of the project, i.e., a benefit/cost ratio greater than unity. Such a condition is preferable if there is to be Federal contributions toward the project.

The choice of 50-years as the project (and therefore economic) life is based on a number of factors. Economic and physical constraints such as physical depreciation of adjacent shore structures, shoaling, obsolescence, changing

requirements for project services, and inaccuracies of overly lengthy projections are considerations in this choice.

Benefits are evaluated as the gain in annual return received by recreational boaters if the harbor is improved; where annual return represents "the net return on depreciated investment in boats as received by owners of 'for-hire' vessels, after all expenses have been paid." The approximate range of annual return to recreational boating using the "for-hire" analogy has been estimated in a study of recreational boating in the United States. The ranges are: 10 to 15 percent for outboards, 8 to 12 percent for inboards; 6 to 9 percent for cruisers; 8 to 12 percent for sailboats; and 6 to 9 percent for auxiliary sailboats. For purposes of this analysis, motorized boats longer than 29 ft. are considered inboards, and sailboats longer than 29 ft. are considered auxiliary sailboats.

Costs are divided into two categories:

1. First Costs-Capital Costs
   (Includes plans and specifications; supervision and administration costs for construction program)

2. Annual Costs
   (Includes operating costs, service of debt or investment cost)

The estimated First Costs for this project, allocated to the contributing source (Federal vs. non-Federal), are detailed in Table 4. In single purpose recreational navigation projects such as that proposed, the first costs of the general navigation facilities (entrance and access channels,

TABLE 4 ESTIMATED FIRST COSTS

	500 Berth Scheme	1000 Berth Scheme
Federal Project		
Breakwaters	$ 7,790,000	$10,995,000
Island Construction (50%)	1,847,000	5,813,000
Contingencies	964,000	1,681,000
Estimated Contract Cost	10,601,000	$18,489,000
Engineering and Design[1]	11,890,000	2,563,000
Sub-total	$11,890,000	$21,052,000
Less: Funds to be contributed	5,945,000	10,526,000
Net Construction Cost	$ 5,945,000	$10,526,000
Aids to Navigation[1]	37,000	37,000
TOTAL FEDERAL FIRST COSTS	$ 5,982,000	$10,563,000
Non-Federal Project		
Site Clearing	$ 60,000	$ 15,000
Island Construction (50%)	1,847,000	5,813,000
Elevated Causeway	-	936,000
Roads[4]	140,000	168,000
Landscaping	131,000	657,000
Signage and Area Lighting	58,000	79,000
Boat Launching Ramp	48,000	64,000
Paving	175,000	296,000
Public Restrooms	168,000	269,000
Buildings[2]	878,000	878,000
Utilities Systems[3]	489,000	798,000
Storm Drainage	72,000	135,000
Dock Structures	906,000	$ 2,180,000
Contingencies	498,000	1,229,000
Estimated Contract Cost	$ 5,470,000	$13,517,000
Non-Federal/Local Cost		
Plus: Local Share of Federal Project	5,945,000	10,526,000
TOTAL LOCAL COST	$11,415,000	$24,043,000

1-Cost includes 10% contingency allowance

2-Administration, Fuel Station, Boat Storage

3-Power, water, sewer

4-Including changes to existing access roads

jetties, breakwaters, turning basins, maneuvering area, and bridge alterations) are shared equally by Federal and non-Federal interests. The balance of the project costs are considered to be non-Federal and must be funded by local interests. In the two schemes studied, Federal and non-Federal project costs are estimated as follows:

	500 Berth Scheme	1000 Berth Scheme
Federal Project Cost	$ 5,982,000	$10,563,000
Non-Federal Project Cost	11,415,000	24,043,000
Total Project First Cost	$17,397,000	$34,606,000

The annualized charges relating to these First Costs are shown in Table 5. Note that interest and amortization charges are based on 6 7/8 percent as prescribed by the Corps. The total Federal and non-Federal annual charges are used in the benefit/cost analysis.

The analysis of recreational craft benefits are shown in Tables 6 and 7. The number, size, and type of boats to be based on the proposed marina conform to the findings of the "Lake Michigan Regional Boating Survey and Analysis" published by the Corps of Engineers in July, 1974 and to the size mix presented on page B-10 of our report of July 18, 1978. Depreciated investment figures were obtained from the Corps and represent the results of their survey of boat inventories.

Following is the comparison of benefits and costs:

	500 Berth Scheme	1000 Berth Scheme
Annual Benefits	$ 790,300	$1,432,590
Annual Cost	1,440,000	$2,730,000
Benefit/Cost Ratio	.549	.525

TABLE 5 ESTIMATED ANNUAL COST

	500 Berth Scheme	1000 Berth Scheme
Federal Project		
Federal Cost	$ 5,982,000	$10,563,000
Annual Charges (50 year project life)		
Interest @ 0.06875	$ 411,000	$ 726,000
Amortization @ 0.00257	15,000	27,000
Maintenance (Protective Structure)	40,000	60,000
Sand By-passing	40,000	58,000
Maintenance Dredging	20,000	13,000
TOTAL	$ 526,000	$ 884,000
Non-Federal Project		
First Cost	$11,415,000	$24,043,000
Annual Charges (50 year project life)		
Interest @ 0.06875	785,000	$ 1,653,000
Amortization @ 0.00257	29,000	62,000
Maintenance	$ 100,000	131,000
TOTAL	$ 914,000	$ 1,846,000
TOTAL FEDERAL & NON-FEDERAL ANNUAL CHARGES	$ 1,440,000	$ 2,730,000

TABLE 6

DERIVATION OF RECREATIONAL CRAFT BENEFITS

(1000 BERTH SCHEME)

Type of Craft	Length (feet)	No. of Boats	Depreciated Investment Avg./Boat ($)	Depreciated Investment Total ($)	% Return Of/On Investment	Annual Value Investment	Boats On Cruise During 160-Day Season: Avg. No. of Days	Boats On Cruise During 160-Day Season: Percent of Total Season	Boats On Cruise During 160-Day Season: Value to be Deducted
NEW LOCALLY BASED CRAFT AFTER IMPROVEMENT (BERTHS)									
Outboards, Inboards & Cruisers	16-25	55	$ 4,000	$ 620,000	11	$ 68,200	15	9.375%	$ 6,400
Inboards & Cruisers	26-41	325	$18,000	$5,850,000	8	$ 468,000	30	18.750%	$ 87,750
	42+	50	$55,000	$2,750,000	8	$ 220,000	30	18.750%	$ 41,250
Sailboats	19-29	130	$11,500	$1,495,000	11	$ 164,450	15	9.375%	$ 15,400
	30-41	125	$20,000	$2,500,000	8	$ 200,000	30	18.750%	$ 37,500
	42+	15	$50,000	$ 750,000	8	$ 60,000	30	18.750%	$ 11,250
TOTAL		800				$1,180,650			$199,550

NET BENEFIT: $1,180,650 - $199,550 = $981,100/year

Type of Craft	Length (feet)	No. of Boats	Depreciated Investment Avg./Boat ($)	Depreciated Investment Total ($)	% Return Of/On Investment	Annual Value Investment	Boats On Cruise During 160-Day Season: Avg. No. of Days	Boats On Cruise During 160-Day Season: Percent of Total Season	Boats On Cruise During 160-Day Season: Value to be Deducted
NEW LOCALLY BASED CRAFT AFTER IMPROVEMENT (DRY STORAGE)									
Outboards	16-25	50	$ 2,500	$125,000	13	$ 16,250	15	9.375%	$ 1,520
Inboards & Cruisers	16-25	50	$ 4,000	$200,000	10	$ 20,000	30	18.750%	$ 3,750
	26-41	50	$18,000	$900,000	8	$ 72,000	30	18.750%	$13,500
TOTAL		150				$108,250			$18,770

NET BENEFIT: $108,250 - $18,770 = $89,480/year

TABLE 6 (continued)

DERIVATION OF RECREATIONAL CRAFT BENEFITS

(1000 BERTH SCHEME)

Type of Craft	Length (feet)	No. of Boats	Depreciated Investment Avg./Boat	Depreciated Investment Total	% Return Of/On Investment	Annual Value Investment
TRANSIENT CRAFT AFTER IMPROVEMENT						
Outboards, Inboards & Cruisers	16-25	39	$ 4,000	$ 156,000	11	$ 17,160
Inboards & Cruisers	26-41	81	$18,000	$1,458,000	8	$116,640
	42+	12	$55,000	$ 660,000	8	$ 52,800
Sailboats	19-29	33	$11,500	$ 379,500	11	$ 41,750
	30-41	31	$20,000	$ 620,000	8	$ 49,600
	42+	4	$50,000	$ 200,000	8	$ 16,000
		200				$293,950

Type of Craft	Length (feet)	No. of Boats	Depreciated Investment Avg./Boat	Depreciated Investment Total	% Return Of/On Investment	Annual Value Investment
Outboards	16-25	41	$ 2,000	$ 82,000	13	$ 10,660
Inboards & Cruisers	16-25	21	$ 4,000	$ 84,000	10	$ 8,400
		62				$ 19,060

TABLE 7 SUMMARY OF ESTIMATED ANNUAL BENEFITS AND THEIR ALLOCATIONS

	Total Annual Benefits	
	500 Berth Scheme	1000 Berth Scheme
Recreational Navigation		
New locally-based craft		
a. Berths	$ 490,550	$ 981,100
b. Dry Storage	89,480	89,480
Transient craft	146,975	293,950
New trailer-drawn boats	14,295[2]	19,060[1]
TOTAL ANNUAL AVERAGE NAVIGATION BENEFITS	$ 741,300	$1,383,590
Recreation (Sport fishing)		
7000 angler-days @ $7/day	$ 49,000	$ 49,000
TOTAL	$ 790,300	$1,432,590

1-4 launching ramps
2-3 launching ramps

Based upon the above, it appears that the schemes as proposed would not qualify for Federal funding, due to the low benefit/cost ratio.

Local Economics

Other factors enter into the economic feasibility analysis which are not recognized by the Federal government but which may contribute to the viability of the project from a local view-point. These involve the establishment of selected commercial uses in the vicinity of the marina.

The two schemes propose the construction of an island of sufficient size to permit construction of one or more restaurants, chandlery, and yacht-club adjacent to the berthing areas. Although the exact size and type of commercial use has not been defined, we have suggested that building pad areas and sufficient parking be set aside for these uses as follows:

	500 Berth Scheme	1000 Berth Scheme
Restaurants & Snack Bar	1 + shops	3 + shops
Chandlery & Boat Sales[1]	1 (incl. in admin. building)	1 (free-standing structure)
Yacht-Club	None	1
Total Land Area[2]	110,000 sq.ft.	610,000 sq.ft.

1-In the 500-Berth Scheme, the chandlery and boat sales area will be included in the administration buidling in leased space.

2-In the 500-Berth Scheme, includes restaurant only.

	500 Berth Scheme	1000 Berth Scheme
Estimated Land Value (fully improved)	$7/sq.ft. equals $770,000	$8/sq.ft. equals $4,880,000
Annual Ground Lease Income (NNN) @ 9%	$69,300	$439,200

Total project annual income is estimated as follows:

Marina Operations	500 Berth Scheme	1000 Berth Scheme
Berth Rentals		
a. Permanently based boats[1]	$320,000	$640,000
b. Transient boats[2]	160,000	320,000
Boat Launchings	19,000[6]	25,000[3]
Dry Boat Storage[4] (150 spaces)	30,000	30,000
Sub-Total-Marina Operations	$529,000	$1,015,000
Space Rental		
Chandlery/Boat Sales[5]	$ 72,000	-
Fuel Station	7,000	$ 10,000
Ground Leases	$ 69,300	$ 439,200
Total Income	$677,300	$1,464,000

1-80% of berths assigned to permanently based boats; $800 per season
2-Based up $10 per day for 160 day season
3-Based on 4 ramps, 2500 launches per season, $2.50 per launch
4-At $250 per space per season
5-10,000 sq.ft. at $7.20/sq.ft./year NNN
6-Based on 3 ramps, 2500 launches per season, $2.50 per launc

	500 Berth Scheme	1000 Berth Scheme
Less: Operating Costs		
Administration	$ 35,000	$ 50,000
Maintenance	250,000	350,000
Total	$285,000	$400,000
NET INCOME AVAILABLE FOR DEBT SERVICE	$392,300	$1,064,000

The income expected from the project will be insufficient in itself to service the debt connected with the project, even if the Federal government participated in the project. The net income available, if utilized to service a long-term (50-year) debt at 6 7/8 percent interest, would be sufficient to carry the following project indebtedness:

500-Berth Scheme - $ 5,501,000
1000-Berth Scheme - $14,919,000

This would leave a substantial portion of the project cost to be funded with other local revenues or from other funding sources.

Benefit Assumptions:

1. That 20 percent of the total berths will be set aside as transient spaces, the balance of 80 percent to be for new locally based craft.

2. That the boating "season" is 160 days, including all of the months of May through September, as well as

seven additional boating days in late April and early October.

3. That the size and value mix of transient craft is the same as that for locally-based craft.

4. That the equivalent of 4 launching lanes will be installed as part of the project, each with a capacity of 2500 launches per season, or 10,000 launches total. This is the equivalent of 62 permanently-based craft (10,000 launches ÷ 160-day season).

5. That for conditions prevailing in the project vicinity, reasonable annual rates of return are: 8 percent for inboards, 11 percent for the mix of outboards/inboards-outdrives; 11 percent for sailboats; 8 percent for auxiliary sailboats; and 13 percent for outboards alone.

5.0 Alternative Marina Schemes

Scheme 2-500 Marina

Configuration

This scheme consists of an approximately square basin connected to the shore south of the Central Park Waterworks with a landfill pad. The basin, which is sized to accommodate 500 boats, is enclosed by two breakwaters with an entrance open to the south-southeast. A sediment trap is incorporated at the northerly side of the pad to impound the predominantly south-moving littoral drift for subsequent bypassing. With the exception of limited parking and a fuel dock on a central mole projecting into the basin, all facilities are concentrated on the landfill connecting the basin to shore. A total of 3 launch lanes are provided for trailered craft.

In light of the limited length of shoreline available for marina development, the presence of water intake lines lakeward of the Waterworks, and the need to minimize the impact on adjacent properties, it is our opinion that a marina of 500 berths is the largest appropriate for consideration as a shore-attached configuration.

Figure 19 shows the schematic plan of the 2-500 marina scheme.

Facilities and Coverage

The shore connected marina scheme has the following approximate area coverage:

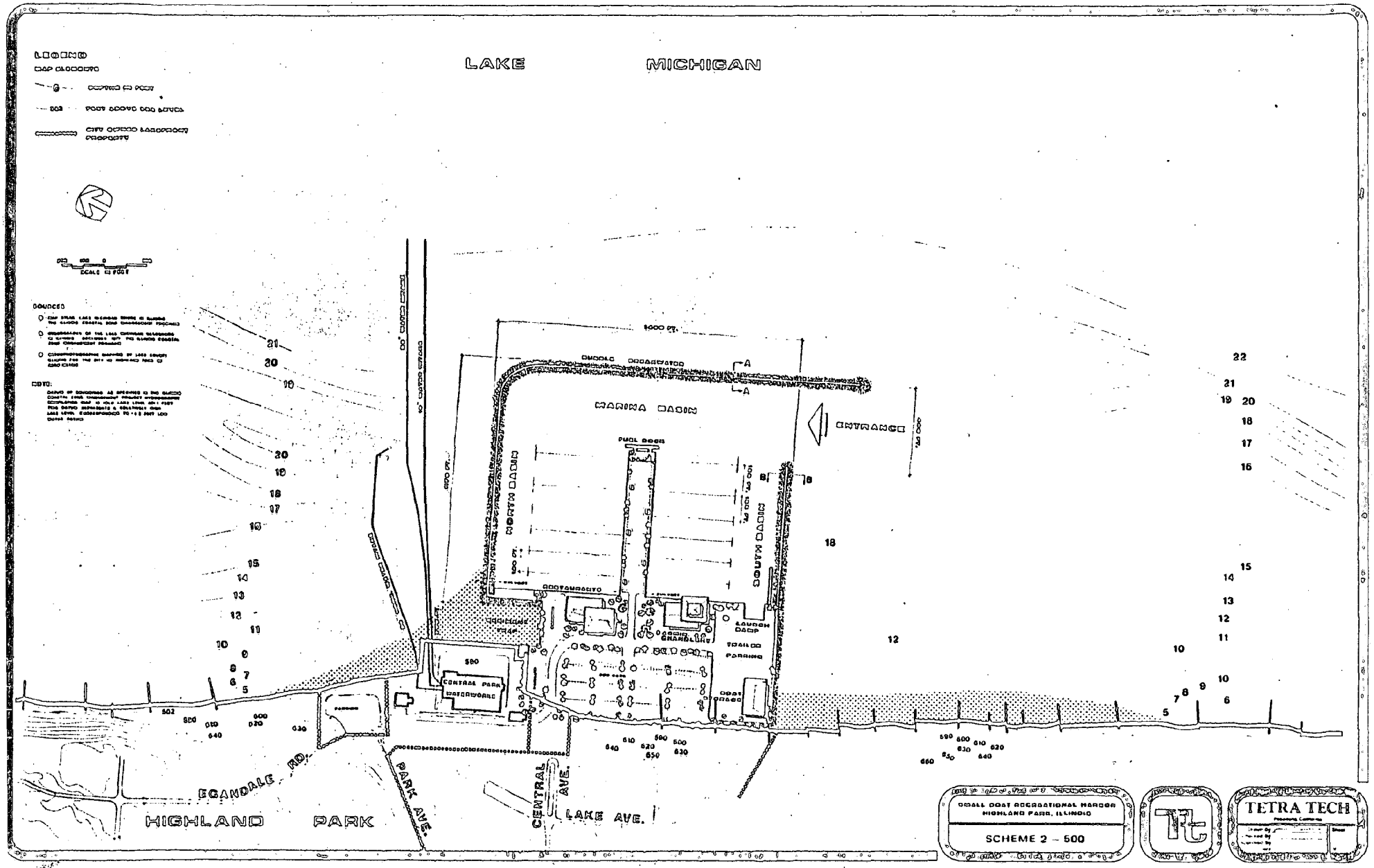


FIGURE 19 2–500 MARINA SCHEME

Total	- 51.50 Acres
Land Coverage	- 22.55 Acres
Water Coverage	- 28.95 Acres

Berthing Density, Boats/$Acre_W$ 17.27

Facilities provided in the 2-500 scheme have been selected from the criteria list, Section D, with modifications to accommodate specific local requirements, such as minimum transient (i.e., trailered boats) traffic, minimal commercial facilities and no hotel/motel facilities.

Facilities provided for 2-500 include:

Marina administration provided service/facilities

Administration Building	18,000 square feet
Chandlery, boat sales, snack bar	11,200 square feet
Fuel station/pumpout facility	1,600 square feet
Restrooms, lockers (5)	600 square feet
Boat Storage Building	18,000 square feet
Launch ramp	3 (15' wide)
Parking - trailers	60-80
Parking - cars	360
Fueling - service dock	1 (150')
Launch tie-up dock	1 (180')
Double slips	250 (500 boats)

Lessee provided services/facilities

Restaurant #1	9,000 square feet
Restaurant #2	12,000 square feet

Order-of-Magnitude Cost Estimate

To establish the economic feasibility of this configuration an order-of-magnitude budget cost estimate was made. All costs were considered in 1978 dollars to be used in the cost-benefit analysis.

Basis for cost estimates include a number of sources:

a. Engineering News Record construction cost index;
b. Engineering News Record building cost index;
c. U.S. Corps of Engineers various offices;
d. Architectural Data Corporation Preliminary Cost Guide index.

Unit costs, where indicated, are total construction costs to the owner and include labor, materials, contractors overhead and profit.

Cost estimates include the total marina facility development and those structures provided by the marina operators. Lessee structures, such as restaurants to be constructed on leased marina land, are not included as part of the development cost.

Infrastructural elements considered in all cost assessments are:

a. electrical power and distribution
b. potable water system
c. sanitary sewer system and lift pumps
d. storm drainage system
e. area lighting and distribution network

TABLE 8 COST ESTIMATE SCHEME 2-500

CONSTRUCTION COST ESTIMATE

REFERENCE/PLAN NO. SCHEME 2-500 JOB NAME

LOCATION Highland Park-Illinois Marina JOB NUMBER TC-3212

PRELIMINARY [x] FINAL [ ]

BY C.L./G.Z. DATE 8/22/78

CHECK DATE

LINE	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1.	Site Clearing	-	LS	-	$ 60,000
2.	Dredging	-	CY	-	-
3.	Excavation-Dry	-	CY	-	-
4.	Breakwater-A	-	LS	-	6,770,000
5.	Breakwater-B	-	LS	-	1,020,000
6.	Land (Fill) Construction	-	LS	-	3,694,420
7.	Elevated Causeway	-	LF	-	-
8.	Shore Protection	-	LF	-	-
9.	Boat Launch Ramp	3	EA	16,000	48,000
10.	Road-40 Ft.	1700	LF	31.50	53,550
11.	Road-30 Ft.	220	LF	25.80	5,676
12.	Signage	-	LS	-	13,000
13.	Landscaping	62,800	SF	2.09	131,252
14.	Paving	403,200	SF	.435	175,392
15.	Bldg.-Administration	11,000	SF	50.54	555,940
16.	Bldg.-Fuel Station	1,600	SF	41.00	65,600
17.	Bldg.-Boat Storage	18,000	SF	14.25	256,500
18.	Bldg.-Restroom	5 x 600	SF	56.00	168,000
19.	Navigational Aids	-	LS	-	34,000
20.	Power Distribution	-	LS	-	300,000
21.	Water Distribution	-	LS	-	89,360
22.	Sewers	-	LS	-	99,530
23.	Storm Drainage	-	LS	-	72,020
24.	Area Lighting/Std's.	50	EA	900	45,000
25.	Access Road-Change	-	LS	-	81,000
26.	Dock Structures	-	LS	-	906,000
27.	Engineering and Design	-	8%	-	1,171,539
	TOTAL				$15,815,779
	Contingencies	10%			1,581,578
	TOTAL PROJECT COST				$17,397,357

CONSTRUCTION COST ESTIMATE - SHEET NO. 1 OF 1

f. roadways
g. walkways and landscaping hardscape
h. parking lot paving and striping
i. landscape development
j. signage
k. connecting causeway/bridge
l. navigational aids and system
m. access roadway modifications
n. dock structures, guide piles and accessories

The attached construction cost estimate form Table 8 summarizes Scheme 2-500 budget cost estimates, totaling $17,397,357.

Scheme 4-1000 Marina

Configuration

Scheme 4-1000 is an artificial offshore island with two associated breakwaters enclosing a rectangular basin. The marina entrance faces south-southeast. Berths for 1000 boats and 4 launch lanes for trailered craft are provided. The basin is subdivided into 3 berthing areas by two moles, the southerly of which houses a fuel dock and both of which provide restroom and limited parking facilities. The remaining parking and ancillary facilities are located on the landfill which comprises the western boundary of the basin, while an elevated causeway provides single-point access from shore.

In contrast to a shore-attached configuration, the offshore island concept minimizes the disruption of littoral transport processes while simultaneously providing a degree of shoreline protection in its wave shadow. Additional benefits include separation of the marina activities from

adjoining property-owners, provision of a semi-sheltered and expanded bathing beach along the city-owned lakefront, and excellent security control resulting from the single-point access.

Figure 20 shows the schematic plan of the 4-1000 marina scheme.

Facilities and Coverage

This offshore island scheme marina has the following approximate area coverage:

Total	- 104.57 acres
Land Coverage	- 44.74 acres
Water Coverage	- 59.83 acres

Berthing density, boats/acre$_w$ = 16.71

Facilities planned for the 4-1000 marina were also selected from the criteria list in Section D, but expanded considerably to provide a more comprehensive mix of land use and recreational opportunities. Consideration was given to minimize transient marina user influx, and hotel/motel facilities were not considered at all.

Specific facilities selected for the 4-1000 marina scheme include the following:

Marina administration provided services/facilities

Administration Building	11,000 square feet
Fuel station/pumpout facility	1,600 square feet
Restrooms, lockers (8)	600 square feet

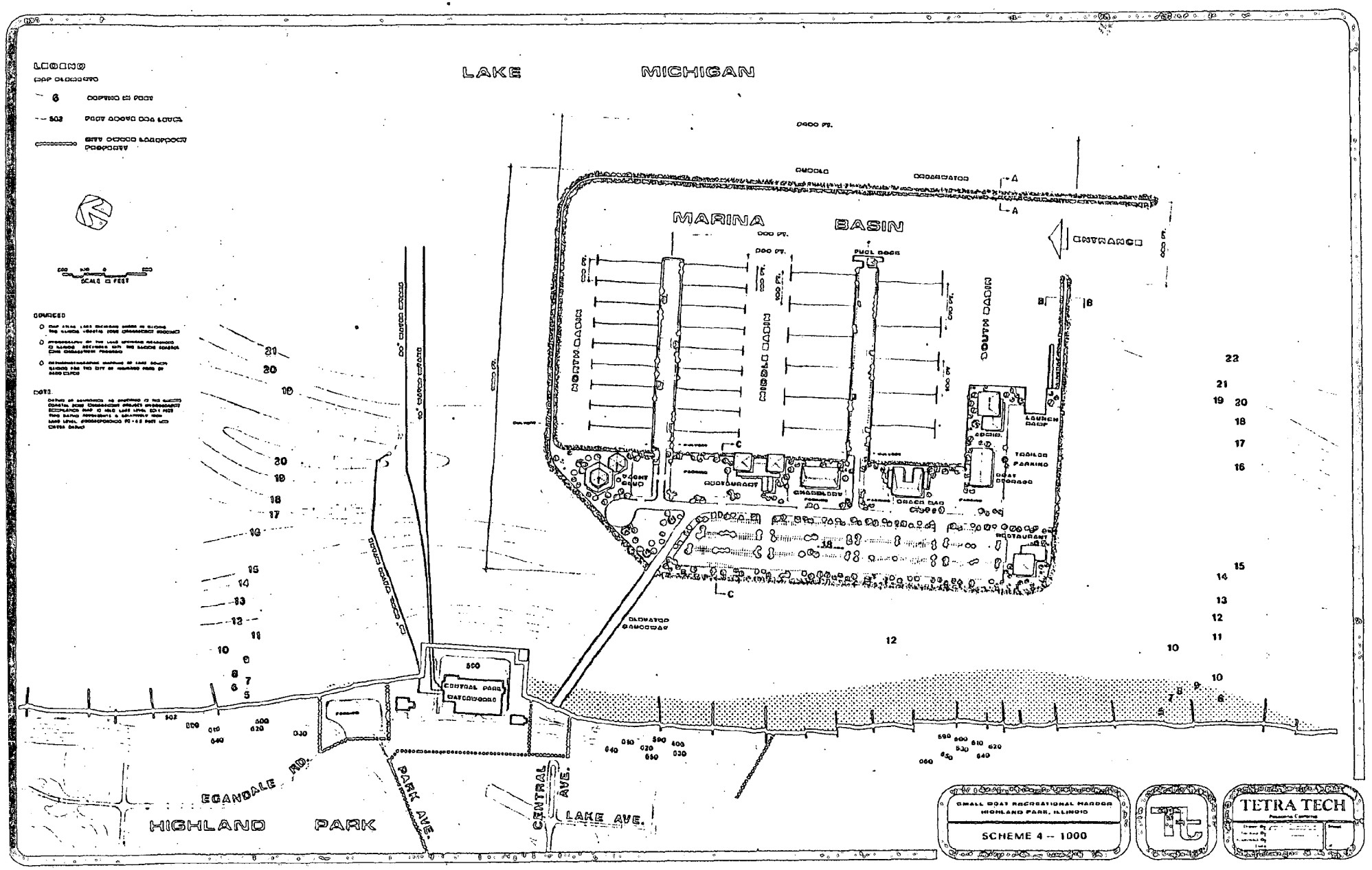


FIGURE 20 4–1000 MARINA SCHEME

Boat Storage Building	18,000 square feet
Launch ramp	4 (15' wide)
Parking - trailers	120-140
Parking - cars	760
Fueling - service dock	1 (150')
Launch tie-up dock	1 (200')
Double slips	500 (1000 boats)

Lessee provided services/facilities

Restaurant #1	9,000 square feet
Restaurant #2	12,000 square feet
Chandlery, boat sales	11,200 square feet
Snack bar	5,000 square feet
Yacht Club/ meeting facilities	10,000 square feet

Order-of-Magnitude Cost Estimate

Similar to Scheme 2-500 cost estimate, the budget cost assessment of Scheme 4-1000 is all inclusive excluding only lessee provided structures. Construction Cost Estimate Form Table 9 summarizes Scheme 4-1000 costs in 1978 dollars. Overall budget costs for Scheme 4-1000 are $34,606,160.

Scheme 6-1000 Marina

Configuration

Like Scheme 4-1000, Scheme 6-1000 consists of an artificial offshore island and associated breakwaters enclosing a 1000-berth basin. The schemes differ, however, in that the landfill for Scheme 6-1000 is in the shape of a "T" with the base of the "T" parallel to shore and dividing the protected

TABLE 9 COST ESTIMATE SCHEME 4–1000

CONSTRUCTION COST ESTIMATE

REFERENCE/PLAN NO. SCHEME 4-1000
LOCATION Highland Park-Illinois Marina

JOB NAME
JOB NUMBER TC-3212
PRELIMINARY [X] FINAL [ ]
BY C.L./G.Z. DATE 8/22/78
CHECK DATE

LINE	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1.	Site Clearing	-	LS	-	$ 15,000
2.	Dredging	-	CY	-	-
3.	Excavation-Dry	-	CY	-	-
4.	Breakwater-A	-	LS	-	10,195,000
5.	Breakwater-B	-	LS	-	800,000
6.	Island (Fill) Construction	-	LS	-	11,626,000
7.	Elevated Causeway	900	LF	26.00	936,000
8.	Shore Protection	-	LF	-	-
9.	Boat Launch Ramp	4	EA	16,000	64,000
10.	Road-40 Ft.	2350	LF	31.60	74,260
11.	Road-30 Ft.	500	LF	25.80	12,900
12.	Signage	-	LS	-	25,000
13.	Landscaping and Irrigation	314,500	SF	2.09	657,305
14.	Paving	680,500	SF	.435	296,000
15.	Bldg.-Administration	11,000	SF	50.54	555,940
16.	Bldg.-Fuel Station	1,600	SF	41.00	65,600
17.	Bldg.-Boat Storage	18,000	SF	14.25	256,500
18.	Bldg.-Restroom	8 x 600	SF	56.00	268,800
19.	Navigational Aids	-	LS	-	34,000
20.	Power Distribution	-	LS	-	460,000
21.	Water Distribution	-	LS	-	162,400
22.	Sewer System	-	LS	-	175,260
23.	Storm Drainage	-	LS	-	135,200
24.	Area Lighting/Std's.	60	EA	900	54,000
25.	Access Road-Changes	-	LS	-	81,000
26.	Dock Structures	-	LS	-	2,179,600
27.	Engineering and Design	-	8%	-	2,330,381
	TOTAL				$31,460,146
	Contingencies	-	10%	-	3,146,015
	TOTAL PROJECT COST	-	LS	-	$34,606,160

CONSTRUCTION COST ESTIMATE · SHEET NO. 1 OF 1

water area into two rectangular berthing basins elongated in the alongshore direction. The easterly and southerly boundaries of the marina basin are provided by two breakwaters, with an entrance between them facing south-southeast. The landward or westerly side of the basin is largely open, permitting easy access by shallow-draft craft. A total of 4 launch lanes are provided. A fuel dock, administration building and restaurant are envisioned for the foot of the T-shaped fill area (near the main entrance channel) with restrooms and considerable parking along the base of the "T" adjacent to the berthing basins. Additional parking, a chandlery, restaurant, yacht club, and launching facilities are located on the top of the "T", with single-point access from shore provided by an elevated causeway.

As in the case of Scheme 4-1000, this configuration offers the advantages of separating the marina activities from adjoining property-owners, provision of a semi-sheltered and expanded bathing beach along the city-owned lakefront, and excellent security resulting from single-point access. Because the island-breakwater complex is elongated in the alongshore direction, it will deter the littoral transport process to a greater extent than Scheme 4-1000. On the benefit side, however, is the protection of a greater length of shoreline in its wave shadow. In comparison with the other schemes considered, the T-shaped island concept offers the additional assets of good flushing characteristics due to its non-enclosed landward side, optimum location for the fuel dock and administration building, and ample parking adjacent to all slips.

Figure 21 shows the proposed schematic plan for the 6-1000 marina scheme.

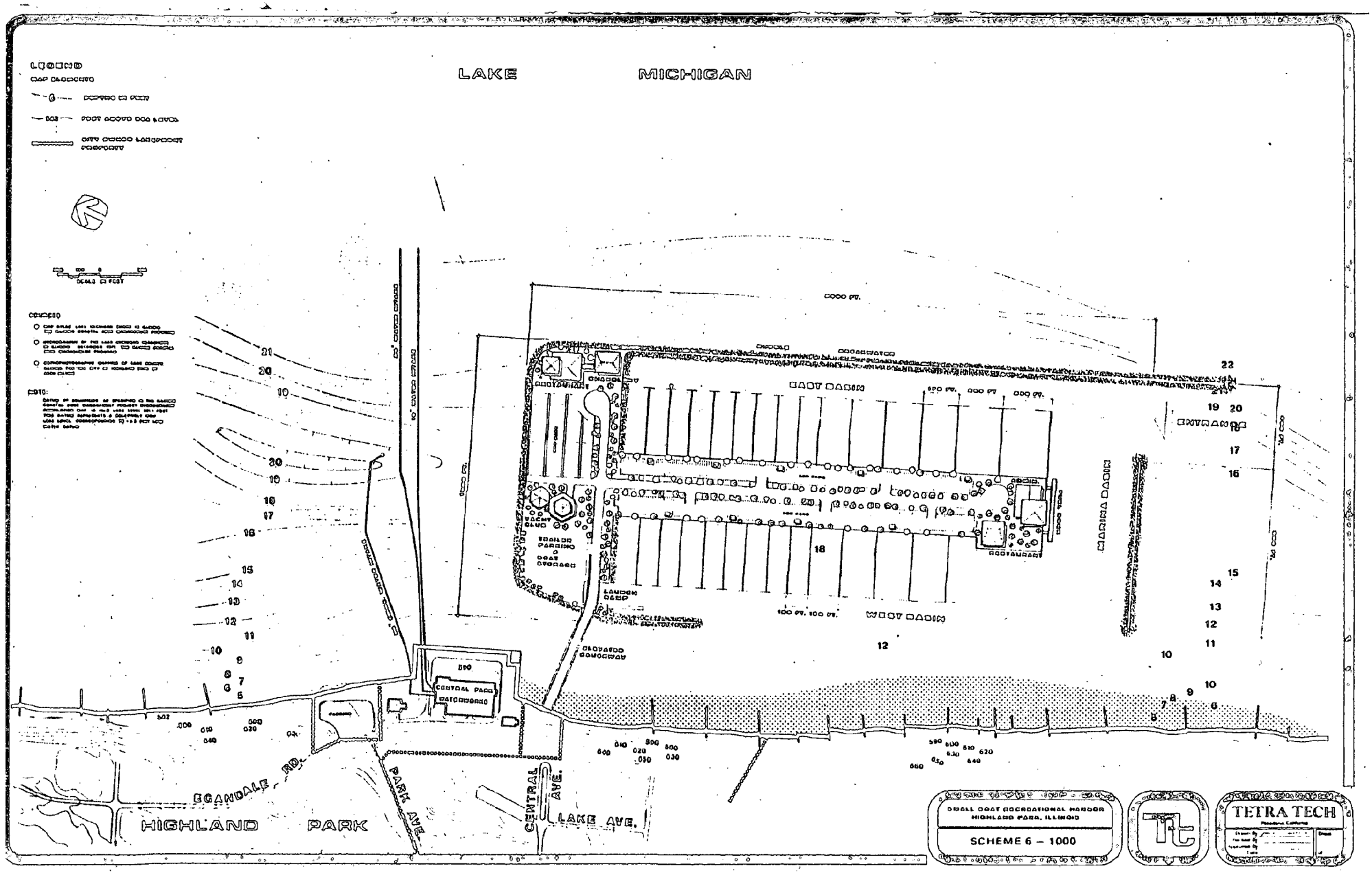


FIGURE 21 6–1000 MARINA SCHEME

Facilities and Coverage

This T-shaped offshore island marina has the following approximate area coverage:

Total	- 88.96 acres
Land Coverage	- 40.61 acres
Water Coverage	- 48.35 acres

Berthing density, boats/acre$_w$ = 20.68

Facility mix for the 6-1000 marina is very similar to the 4-1000. Differences exist principally in parking accommodations and overall land utilization. As before, facility elements generating transient users have been kept to a minimum. Hotel/motel facilities have been omitted.

Specific mix of proposed facilities for the 6-1000 marina scheme is:

Marina administration provided services/facilities

Administration Building	11,000 square feet
Fuel station/pumpout facility	1,600 square feet
Restrooms, lockers (9)	600 square feet
Boat Storage Building	14,000 square feet
Launch ramp	4 (15' wide)
Parking - trailers	100-120
Parking - cars	820
Fueling - service dock	1 (300')
Launch tie-up dock	1 (180')
Double slips	500 (1000 boats)

Lessee provided services/facilities

Restaurant #1	9,000 square feet
Restaurant #2	12,000 square feet
Chandlery, boat sales	11,200 square feet
Snack bar	5,000 square feet
Yacht Club, meeting facilities	10,000 square feet

Order-of-Magnitude Cost Estimate

Cost estimate for the 6-1000 scheme is based on the same sources and includes the same infrastructure elements considered in the previous schemes (Refer to detail of 2-500 marina estimate).

All marina costs considered include total construction costs to the owner, labor, materials, contractors overhead and profit. Estimates are in 1978 dollars.

The overall marina 6-1000 development cost, as per attached cost detail form Table 10, is $30,063,702.

TABLE 10 COST ESTIMATE SCHEME 6–1000

CONSTRUCTION COST ESTIMATE

REFERENCE/PLAN NO. SCHEME 6-1000
LOCATION Highland Park - Illinois Marina

JOB NAME
JOB NUMBER TC-3212
PRELIMINARY ☒ FINAL ☐
BY C.L/G.Z. DATE 9/22/78
CHECK DATE

LINE	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Site Clearing	-	LS	-	15,000
2	Dredging	-	CY	-	-
3	Excavation - Dry	-	CY	-	-
4	Breakwater - A	-	LS	-	6,365,000
5	Breakwater - B	-	LS	-	785,000
6	Breakwater - C	-	LS	-	101,000
7	Island (Fill) Construction	-	LS	-	10,632,000
8	Elevated Causeway	1000	LF	1040	1,040,000
9	Shore Protection	-	LF	-	-
10	Boat Launch Ramp	4	EA	16,000	64,000
11	Road - 40 Ft.	2650	LF	31.60	83,740
12	Road - 30 Ft.	-	LF	-	-
13	Signage	-	AL	-	25,000
14	Landscaping & Irrigation	691,500	SF	2.09	1,445,235
15	Paving	475,200	SF	.435	206,712
16	Bldg. - Administration	11,000	SF	50.54	555,940
17	Bldg. - Fuel Station	1,600	SF	41.00	65,600
18	Bldg. - Boat Storage	14,000	SF	14.25	199,500
19	Bldg. - Restroom	9 x 600	SF	56.00	302,400
20	Navigational Aids	-	LS	-	51,000
21	Power Distribution	-	LS	-	480,000
22	Water Distribution	-	LS	-	189,500
23	Sewers	-	LS	-	170,400
24	Storm Drainage	-	LS	-	106,600
25	Area Lighting/Std's.	60	EA	900	54,000
26	Access Road - Change	-	LS	-	631,000
27	Dock Structures	-	LS	-	1,737,520
28	Engineering & Design	-	8%		2,024,491
	TOTAL				27,330,638
	Contingencies		10%		2,733,063
	TOTAL PROJECT COST				30,063,702

CONSTRUCTION COST ESTIMATE - SHEET NO. 1 OF 1

PLAN EVALUATION

F. PLAN EVALUATION

1.0 General

The three candidate marina alternatives discussed in detail in Section E will be compared and evaluated here to arrive at a single alternative for subsequent planning consideration. Evaluation is done using a weighted value matrix considering key aspects of functional, economic, environmental and socio-political factors for each scheme.

Table 11 shows the principal physical and economic characteristics of Schemes 2-500, 4-1000 and 6-1000, to provide the reader with background for the subsequent evaluation process.

As discussed earlier, none of the marina schemes meet the U.S. Corps of Engineers' Federal Cost Sharing Benefit/Cost ratio criteria, but Scheme 6-1000 has good economic potential to function successfully, given certain facility mix and design adjustments. Table 11 does not identify the Benefit/Cost ratio for the 6-1000 scheme, because its value is similar to Scheme 4-1000 and was not computed in this analysis.

2.0 Rating of Alternatives

Evaluation was done using four major evaluation elements:

a. Functional/Operational Factors
b. Economic Factors
c. Environmental Factors
d. Socio/Political Factors

TABLE 11 PRINCIPAL PHYSICAL AND ECONOMIC MARINA CHARACTERISTICS

	SCHEME 2-500 MARINA	SCHEME 4-1000 MARINA	SCHEME 6-1000 MARINA
Physical Characteristics			
Number of Berths	500	1000	1000
Total Acreage	51.50	104.57	88.96
Acreage - Land	22.55	44.74	40.61
Acreage - Water	28.95	59.83	48.35
Berthing Density	17.27 boats/ac_w	16.71 boats/ac_w	20.68 boats/ac_w
No. of Launch Lanes	3	4	4
Economic Characteristics			
Total Construction Cost	$17,397,000	$34,606,000	$30,063,702
Annual Maint. & Oper. Cost	1,440,000	2,730,000	
Annual Benefits	800,300	1,432,590	See economic
Corps of Eng. B/C Ratio	.556	.525	analysis,
Federal Project Cost	5,982,000	10,563,000	Scheme 6-1000
Non-Federal Project Cost	11,415,000	24,043,000	

Table 12, Alternative Evaluation Matrix, shows the evaluation process and scores as they were applied to the three marina schemes. Each evaluation element considered was assigned an importance factor - F (0 through 10), arrived at in discussions with potential harbor facilities users, agencies and area residents. These factors undoubtedly are subjective judgments, but applied on an equal basis to all schemes provide a relative means for ranking.

The rating factor - R (0 through 3) is used for rating each evaluation element, subsequently to be multiplied by the importance factor - F to arrive at a weighted rating - WR, representing the score for that particular evaluation element. The sum of all WR scores for each marina scheme is the basis for their subsequent ranking.

Functional/Operational Evaluation Factors

Evaluation scores and ranking for the three schemes in this area are:

Scheme 2-500	45 Points	#3
Scheme 4-1000	70 Points	#2
Scheme 6-1000	85 Points	#1

1. Entrance Configuration

The marina entrance configuration is essentially the same for all schemes evaluated. It faces south southeast to provide protection from the most severe wave conditions anticipated. Scheme 2-500 harbor entrance rating is lower to account for tighter turn requirement to enter the south basin.

TABLE 12 ALTERNATIVE EVALUATION MATRIX

EVALUATION ELEMENTS	SCHEME 2-500 MARINA Rating R	WR	SCHEME 4-1000 MARINA Rating R	WR	SCHEME 6-1000 MARINA Rating R	WR	F IMPORTANCE FACTOR* 0-10
FUNCTIONAL/OPERATIONAL FACTORS							
Entrance Configuration	1	6	2	12	2	12	6
Land Use	2	8	2	8	3	12	4
Parking Accommodations	1	5	2	10	3	15	5
Water Exchange/Flushing	2	6	2	6	3	9	3
Refuge	1	3	2	6	3	9	3
Facilities Mix	2	12	3	18	3	18	6
Maintenance	1	5	2	10	2	10	5
ECONOMIC FACTORS							
Total Cost	3	24	2	16	2	16	8
Potential for Fed. Participation	0	0	0	0	1	7	7
Federal Cost/Benefit Ratio	0	0	0	0	0	0	9
Maintenance Costs	1	6	2	12	2	12	6
Potential for Oper. Success	1	10	2	20	3	30	10
ENVIRONMENTAL FACTORS							
Impact on Aquatic Life	2	8	2	8	2	8	4
Impact on Area	3	21	2	14	2	14	7
Impact on Riparian Owners	1	5	2	10	2	10	5
Coastline Impacts	1	6	2	12	3	18	6
Traffic Impacts	2	18	1	9	1	9	9
Impact on Water Quality	3	24	2	16	2	16	8
SOCIO/POLITICAL FACTORS							
Potential for Community Acceptance	3	30	1	10	2	20	10
Potential for Area Acceptance	1	7	2	14	3	21	7
Potential for Agency Acceptance	1	7	2	14	3	21	7
SCORE		211		225		287	
RANKING	03		02		01		

*Based on discussions with U.S. Corps of Engineers, area residents, local and state agencies

R - Rating Factor 0 through 3

F - Importance Factor 0 through 10

WR - Weighted rating (RF)

2. Land Use

Land use ratings for the marinas reflect the overall functional configuration of each, and the constraints of concise planning requirements imposed by the economics of landfill utilization.

The land use efficiency for each scheme is shown by the following acreage/boat coefficients:

Scheme 2-500	0.045 Acres	L/Boat
Scheme 4-1000	0.045 Acres	L/Boat
Scheme 6-1000	0.040 Acres	L/Boat

For Scheme 6-1000, additional land use economies can be achieved by consolidating some of the open space areas and adjusting the landscaped area coverage.

3. Parking Accommodations

Scheme 6-1000's higher score represents the better slip owner parking scheme, with majority of the parking facilities in the immediate vicinity of the pier access points.

All schemes utilize downtown commuter parking facility for peak load accommodation.

4. Water Exchange/Flushing

Although precise flushing characteristics of the various concepts cannot be determined at this time, Scheme 6-1000 has distinct water circulation advantages over Schemes 2-500 and 4-1000. The open west basin, with its four

lane launching facility, will function well under normal operating conditions. Predominant northerly winds will assist in the flushing process of the east basin.

5. Refuge

Scheme 6-1000 rates best in this evaluation, providing the largest marina basin space for storm protection within the marina boundaries and in the area between the marina and the shore. As indicated earlier in the study, single point mooring was eliminated for normal marina operations, but can be considered as an alternative for storm refuge needs.

6. Facilities Mix

Schemes 4-1000 and 6-1000 have a good facilities mix, accommodating most key elements essential for an integrated marina operation of this scope. Scheme 2-500, although self-sufficient for local scale operations, does not have a facility mix for good long term operations. This evaluation factor is also tempered by the expressed community requirement of keeping transient user traffic in the area to a minimum.

7. Maintenance

This factor considers overall marina operational maintenance, control and maintenance dredging aspects and rates both thousand boat schemes superior to the 500 boat scheme, where special sand trap collection and bypassing is a relatively high cost maintenance item.

Economic Evaluation Factors

Evaluation scores and ranking for the three schemes evaluated in this area are:

Scheme 2-500	40 Points	#3
Scheme 4-1000	48 Points	#2
Scheme 6-1000	65 Points	#1

1. Total Cost

This evaluation factor, although of high importance, is not considered as the key economic indicator. Scheme 2-500 was rated higher than the other two schemes because its lower initial cost would have a lesser impact on the community. Construction costs for all schemes are high because of the shore detached island concept design (i.e. larger protected perimeter construction).

2. Potential for Federal Cost Sharing

All marina schemes do not pass the traditional U.S. Corps of Engineers Benefit/Cost Ratio test, and hence are rated at 0; however, Scheme 6-1000 because of its large shore protection potential has some potential in this area if presented as a conservation project.

3. Federal Cost/Benefit Ratio

As indicated above, the cost/benefit ratio on the U.S. Corps of Engineers basis does not approach unity for any of the schemes evaluated.

4. Maintenance Costs

Projected maintenance costs for Schemes 4-1000 and 6-1000 rate about equal and are considered reasonably good. Scheme 2-500 maintenance costs rate a low score.

5. Potential for Operational Success

This is the key economic evaluation factor, encompassing a number of important elements contributing to a marina's long term operational success. Consideration includes such factors as overall construction cost, facility mix, nature and quality of the development, market area, site location, maintenance costs, access, etc. Scheme 6-1000 is rated high in this evaluation, above Schemes 4-1000 and 2-500.

Environmental Evaluation Factors

Evaluation scores and ranking for the three schemes rated in this area are:

Scheme 2-500	82 Points	#1
Scheme 4-1000	69 Points	#3
Scheme 6-1000	75 Points	#2

1. Impact on Aquatic Life

Impacts on fish and lake bottom organisms will be relatively minimal and rated about the same for all three schemes. Construction impacts will be higher than long range operational impacts. Breakwater construction will provide benthic organisms with new habitats.

2. General Impact on Area

Considered as an important factor, the overall marina

impact on the area is rated equal for both 1000 boat schemes and lower for the 500 boat scheme. Since this element is comprised of a mix of diverse positive and negative environmental impacts, the evaluation score represents an average composite value. A detailed environmental impact report would address all aspects in this area to a greater depth, delineating each specific impact and its consequences.

3. Impacts on Riparian Owners

Rating in this area considers the importance and value of the visual, noise and direct traffic impacts generated by the marina project. The importance value reflects the fact that riparian owners represent an important but numerically small fraction of the community.

4. Coastline Impacts

This evaluation factor addresses principally the shore protection value of the marina development. Since the 6-1000 scheme has the largest wave shadow, it received the highest rating. Importance factor of 6 was selected to reflect that the marina conceptual scheme is essentially a harbor design/planning task, not a shore protection task.

5. Traffic Impacts

Traffic impacts from the daily operation of the marina are considered very important. Both Scheme 4-1000 and 6-1000 impacts were rated equal, assuming that the marina is located at the Central Avenue site. Ratings

would remain relative in value for these schemes at any alternate location - such as the Walker Avenue site.

6. Impact on Water Quality

As another important evaluation factor, water quality degradation due to construction and operation of the marina, received a high importance value. Scheme 2-500, because of its totally contained marina basin and land-side attachment, rated more favorably than the other two proposed schemes.

Socio/Political Evaluation Factors

Evaluation scores and ranking for the three schemes in this area are:

Scheme 2-500	44 Points	#2
Scheme 4-1000	38 Points	#3
Scheme 6-1000	62 Points	#1

1. Potential for Community Acceptance

Based on consultants interaction with the community, public surveys conducted at public meetings during the course of the study and public responses by letter and in local press, this evaluation element is one considered key along with potential for economic success. Highest rating is awarded to the 2-500 scheme recognizing that a community scale marina would find the widest acceptance in the immediate project area. Scheme 6-1000 rates high, but second due to its potential for traffic and other indirect impacts.

2. Potential for Area Acceptance

In this evaluation, Scheme 6-1000 has the highest rating - providing the richest mix of marina facilities and the larger number of available slips. Rating substantiated by informal poll at public meeting September 6, 1978.

3. Potential for Agency Acceptance

This rating is based on a number of subjective evaluation judgments encompassing a range of local, state and federal agencies general acceptance of the project. Scheme 6-1000 has the highest score, principally because it provides recreational service to a larger public segment in the area and serves also as a beach erosion control element.

3.0 Discussion of Evaluation Results

Although a number of evaluation and importance factors can be considered subjective, the overall process of ranking the three proposed marina alternatives does indicate which of the alternatives warrants further detailed consideration.

Ranking by the four major evaluation factors show that different schemes rate high in different evaluation areas, but the overall point score is highest for the 6-1000 marina scheme.

Ranking by the various factors was as follows:

	Scheme 2-500	Scheme 4-1000	Scheme 6-1000
Functional/Operational	#3	#2	#1
Economic	#3	#2	#1
Environmental	#1	#3	#2
Socio/Political	#2	#3	#1

Scheme 2-500 has the best environmental factor score principally due to its smaller size and subsequently lesser impacts. Scheme 4-1000 rates second to third in most areas, reflecting its larger size impacts and some idiosyncrasies of the island configuration. Scheme 6-1000, except for the environmental area, rates #1 in all other evaluation factors. Its final overall score of 287 points is 62 points above Scheme 4-1000, ranking #2 and 76 points above Scheme 2-500, ranking #3, indicating generally that it has a number of inherent features superior to the other two schemes.

Based on this evaluation process, Scheme 6-1000 is being further evaluated and is recommended for consideration as the configuration for the Highland Park Marina project. This evaluation process, however, does not fix the specific site location for the marina, which should be analyzed with traffic impact and other environmental factor impacts in mind.

SELECTED PLAN 6-1000R ANALYSIS

G. SELECTED PLAN 6-1000R ANALYSIS

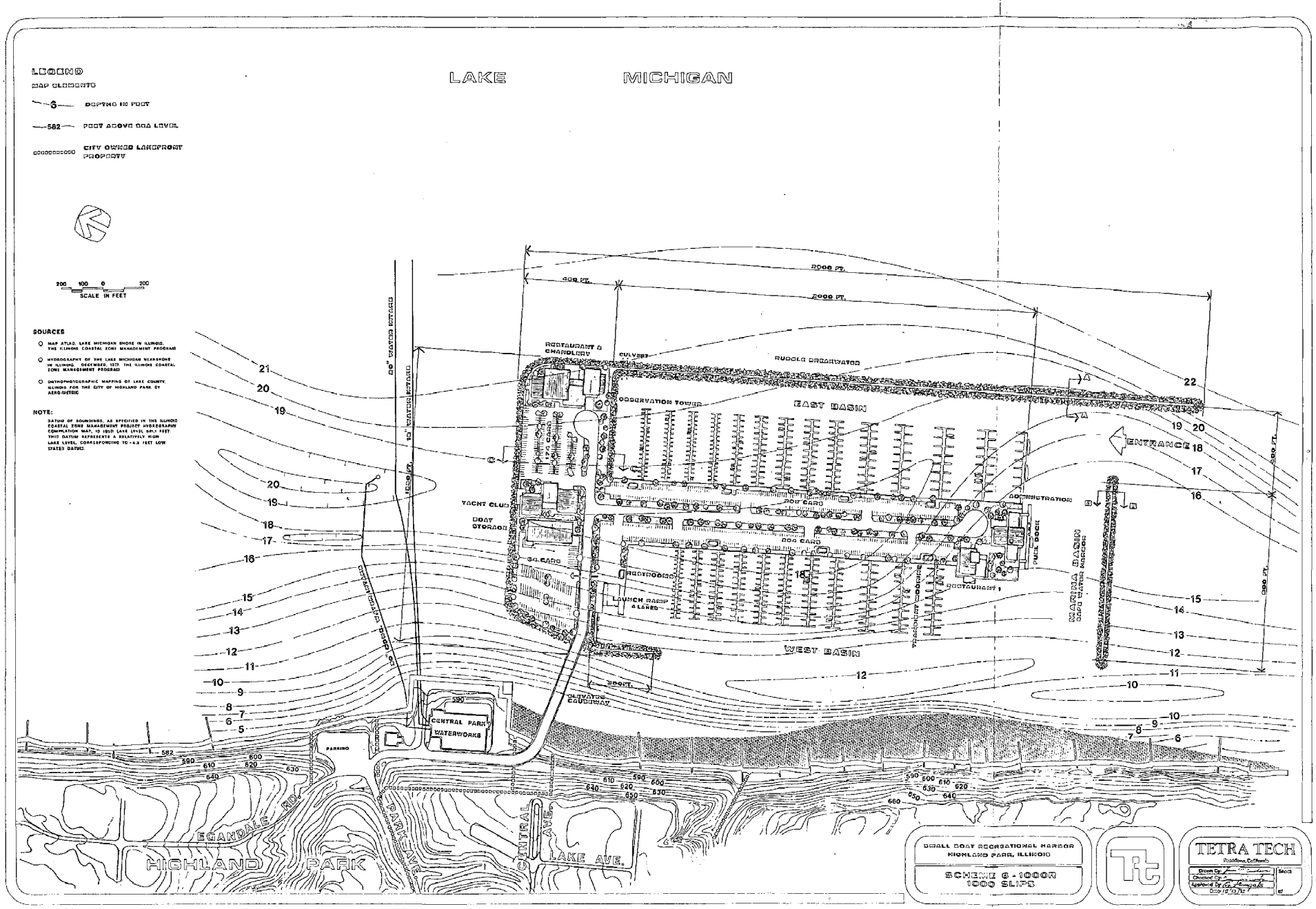
1.0 Marina 6-1000R Definition

Based on the rating scores in Section F, Scheme 6-1000 was selected for subsequent planning refinement and evaluation. Because a number of specific functional planning and design changes have been made to the T-island concept, the marina scheme discussed here will be referred to as Scheme 6-1000R (Scheme 6-1000 Revised).

Major changes made from the previous 6-1000 scheme include:

1. Relocation and reorientation of boat launch ramp to allow for launching of sailboats with masts deployed.
2. Addition/relocation of a restroom/locker facility to serve the launch ramp area.
3. Siting of boat storage facility and expansion of boat/trailer parking area to accommodate up to 110 cars/trailers.
4. Decrease of total marina car parking capacity from 820 to 750 to accommodate item 3 above.
5. Reconfiguration of buildings to accommodate an architectural design vocabulary compatible with the development and to facilitate construction of a 1"-100' scale model.
6. Rearrangement of pier structures to accommodate the specified mix of boat slips.

Figure 22 - Marina Scheme 6-1000R plan shows the new plan configuration. The basic configuration of Scheme 6-1000R


LEGEND
MAP ELEMENTS
-6- DEPTHS IN FEET
-582- FEET ABOVE IGLD LEVEL
CITY OWNED LAKEFRONT PROPERTY
SCALE IN FEET
SOURCES
NOTE:
LAKE MICHIGAN
2000 FT.
400 FT.
2000 FT.
RESTAURANT & CHANDLERY
CULVERT
RUBBLE BREAKWATER
OBSERVATION TOWER
EAST BASIN
ENTRANCE
ADMINISTRATION
YACHT CLUB
BOAT STORAGE
BOAT CARD
RESTROOMS
LAUNCH RAMP 4 LANES
WEST BASIN
MARINA BASIN
FUEL DOCK
RESTAURANT
PEDESTRIAN BRIDGE
ELEVATED CAUSEWAY
CENTRAL PARK WATERWORKS
PARKING
EGANDALE RD.
PARK AVE.
CENTRAL AVE.
LAKE AVE.
HIGHLAND PARK
SMALL BOAT RECREATIONAL HARBOR
HIGHLAND PARK, ILLINOIS
SCHEME 6 - 1000R
1000 SLIPS
TETRA TECH

marina is the same as that of the 6-1000 configuration. Most of the refinement changes made have little bearing on its operation, economics and overall development. Suggested access to the site is shown in Figure 23 and follows the access route selected and discussed in Section D.

The suggested structure design development was kept schematic on purpose - only to approximate a potential architectural vocabulary. Figures 24 and 25 show the principal building elevations. Specific square footages for buildings, although discussed and defined in the criteria and economic analysis, should be adjusted prior to their final design to meet specific user/tenant needs.

Facility elements considered for the 6-1000R development parallel those of the previous schemes and include the following:

Marina administration provided services/facilities
(Elements included in the cost estimate as first costs and provided by the initial developer).

Administration Building	11,000 Square Feet
Marina Management Offices	
Harbor Master Offices	
Weather Forecast Board	
Public Information	
Communications Mast	
Coast Guard Offices	
Fuel Station	1,600 Square Feet
Restrooms/Lockers (9)	600 Square Feet
Trash Collection Area	
Showers	

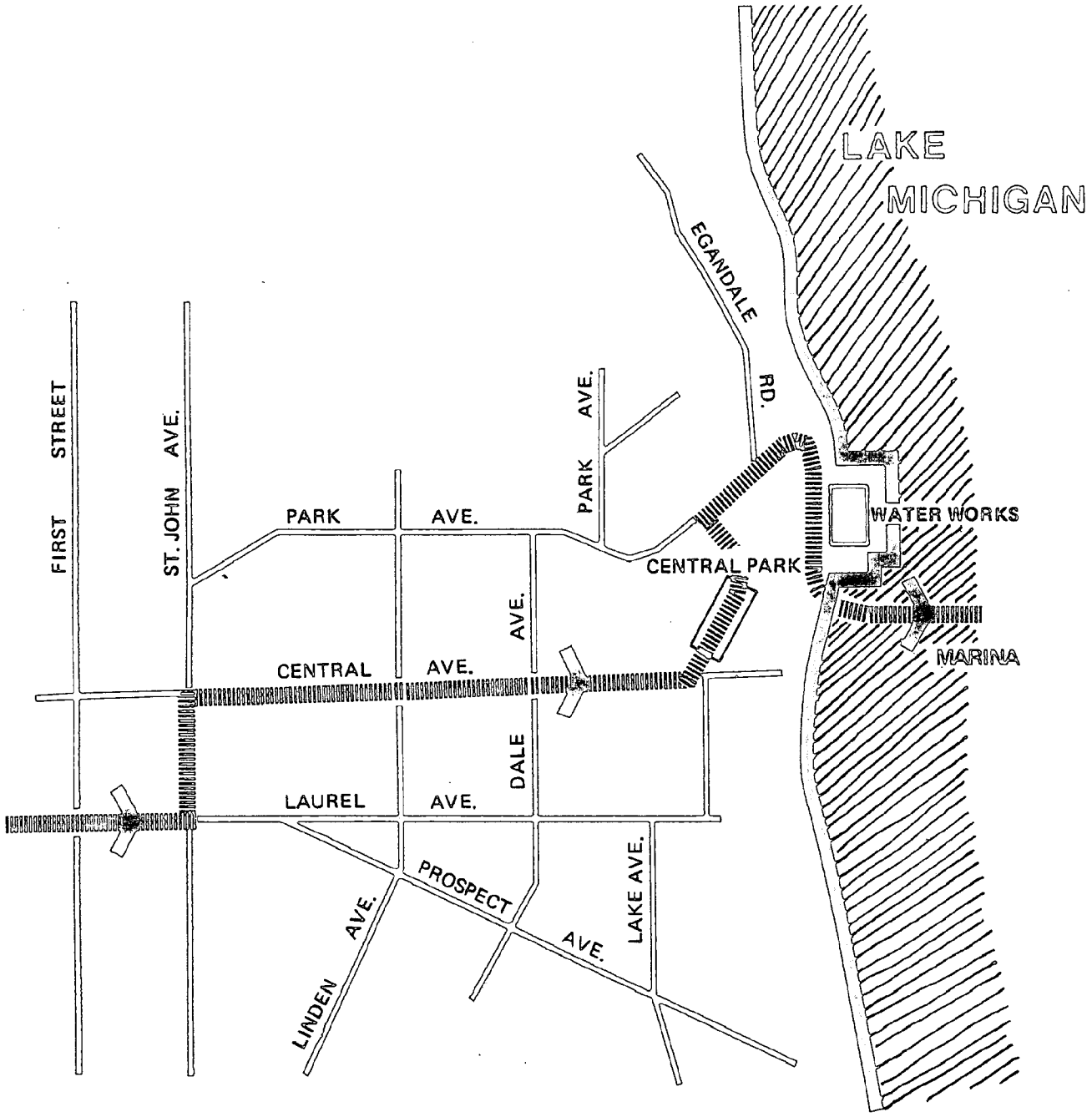
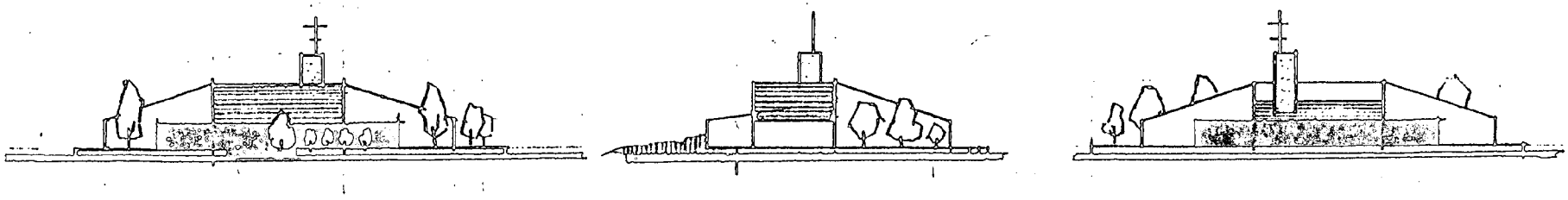
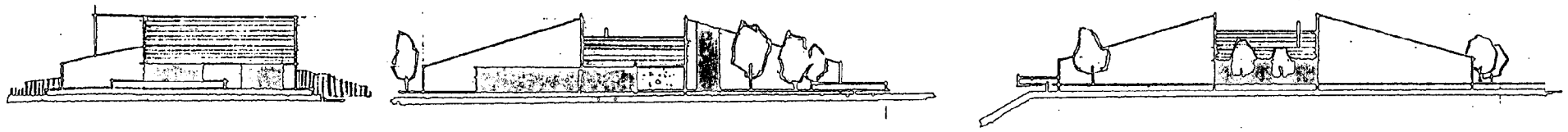


FIGURE 23: SUGGESTED ACCESS ROUTE TO THE CENTRAL AVENUE MARINA SITE



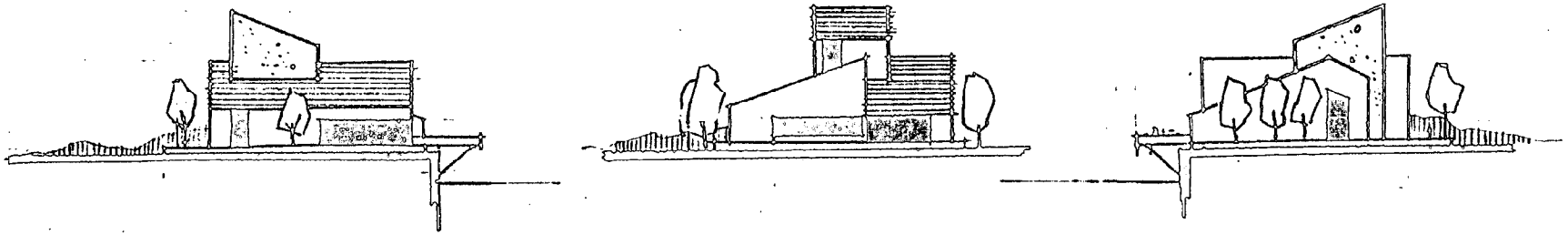
NORTH EAST SOUTH

ADMINISTRATION BUILDING ELEVATIONS



NORTH EAST WEST

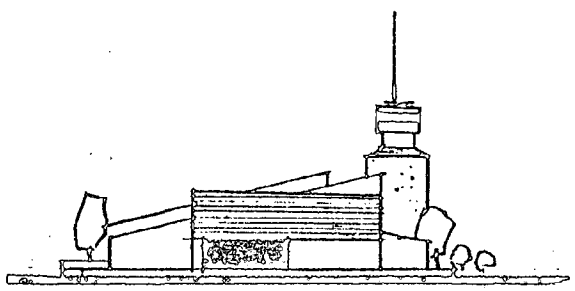
YACHT CLUB BUILDING ELEVATIONS



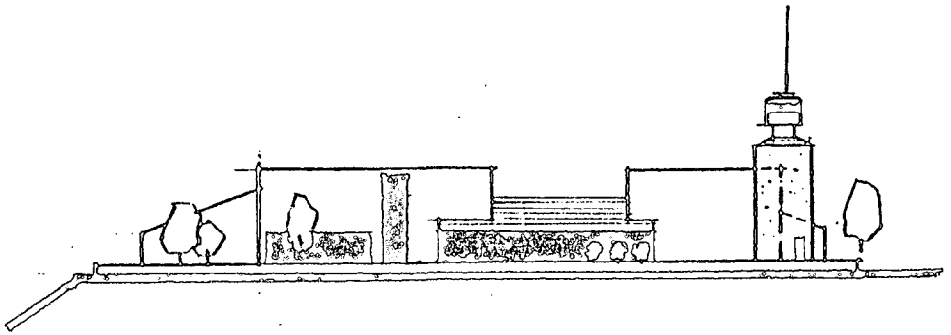
NORTH WEST SOUTH

RESTAURANT #1 BUILDING ELEVATIONS

FIGURE 24 SCHEMATIC BUILDING ELEVATIONS



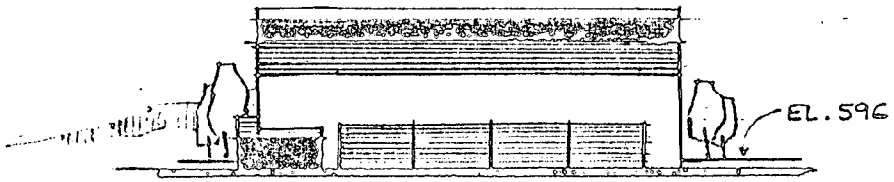
NORTH



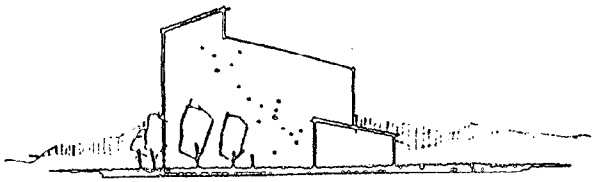
WEST

RESTAURANT #2 BUILDING ELEVATIONS

INCLUDES CHANDLERY, BOAT SALES & OBSERVATION TOWER



WEST



NORTH

BOAT STORAGE BUILDING ELEVATIONS

CAPACITY - 150 BOAT DRY STORAGE

FIGURE 25 SCHEMATIC BUILDING ELEVATIONS

Boat Storage Building Multistory Boat Handling Facility 150+ Boat Capacity	14,000 Square Feet
Boat Launch Ramp	4 (15' Wide)
Parking - Trailers	84-110 Spaces
Parking - Cars	750 Spaces
Fueling - Service Dock Pumpout Facility Bait Shop	1 300' Long
Launch Tie-Up Dock	1 140' Long
Mooring Spaces - Double Slips Accommodating the following mix:	500 Double Slips, 1000 Boat Spaces

18 Foot Length - 90 Spaces
21 Foot Length - 90 Spaces
25 Foot Length - 120 Spaces
29 Foot Length - 220 Spaces
33 Foot Length - 230 Spaces
37 Foot Length - 165 Spaces
45 Foot Length - 85 Spaces

<u>Lessee provided services/facilities</u>
(Elements not included in cost estimate - to be provided by lessees or built for lessees).

Restaurant #1 Observation Deck	9,000 Square Feet
Restaurant #2 Observation Tower/Deck	12,000 Square Feet

Chandlery, Boat Sales (In Restaurant #2 cluster)	11,200 Square Feet
Snack Bar (In Administration cluster)	5,000 Square Feet
Yacht Club, Meeting Facilities	10,000 Square Feet

2.0 Infrastructure for Scheme 6-1000R

Infrastructure elements supporting the 6-1000R marina scheme are similar to those considered in the feasibility analysis for 6-1000. Cost estimates include design and construction of all base utilities, roadways and support elements necessary for operation of the development, including modifications for the access roadway to the marina. Design consideration and costs for expansion of the water plant are not included since these would have to be borne independently whether a marina is constructed or not.

Major infrastructure elements considered for 6-1000R include:

a. Underground electrical power, primary and secondary distribution
   - 1-500 KVA Transformer
   - 1-1000 KVA Transformer

b. Potable water primary, secondary and service systems
c. Sanitary sewer system and lift pumps - 5200 feet
d. Storm drainage system - 4000 feet
e. Area and street lighting, and power distribution network

f. Roadways - primary and secondary - 2650 feet
g. Walkways and landscaping hardscape
h. Landscaping softscape development - 691,500 Square Feet
i. Parking lot paving and striping - 475,200 Square Feet
j. Signage
k. Connecting causeway/bridge
l. Navigational aids and communications system
m. Access roadway modifications
n. Dock structures, guide piles and accessories, including water and power service.

Utility systems are provided to serve all undeveloped/ lessee properties. Lighting system includes lighting standards on docks.

3.0 Cost Estimate for Scheme 6-1000R

Cost estimate for design and construction of the 6-1000R scheme does not vary substantially from the 6-1000. Since construction costs were detailed beyond the conceptual design level during the initial phase of the feasibility analysis, for the economic comparison in this phase we are using the same cost estimate. Costs were considered in 1978 dollars.

Basis for this cost estimate include the following sources:

a. Engineering News Record construction cost index;
b. Engineering News Record building cost index;
c. U.S. Corps of Engineers, regional offices;
d. Architectural Data Corporation, Preliminary Cost Guide Index

Cost estimates include the total marina facility development and those structures provided by the marina operators. Lessee structures, such as restaurants to be constructed on leased marina land, are not included as part of the development cost.

Unit costs, where indicated, are total construction costs to the owner and include labor, materials, contractors overhead and profit.

Table 13 details the Scheme 6-1000R Cost Estimate by major cost items, totalling $30,063,702.

4.0 Economic Analysis Scheme 6-1000R

Schemes 6-1000 and 6-1000R were analyzed for their economic viability using budgetry costs based upon the conceptual plans shown in Figures 21 and 22. Market rents and fees for marina spaces and services were based upon prevailing rates in other nearby marinas escalated to the expected date of availability. As project definition continues and refinement of the final marina configuration is made, the cost and market factors should be more closely identified through more in-depth studies of the region.

Previous benefit-cost analyses of Schemes 2-500 and 4-1000 resulted in benefit-cost ratios significantly below the guideline figure of 1.0 as established by the Corps of Engineers. Therefore, a similar analysis of Scheme 6-1000 was not performed, since the outcome would be the same.

TABLE 13 COST ESTIMATE SCHEME 6–1000R

CONSTRUCTION COST ESTIMATE

REFERENCE/PLAN NO. SCHEME 6-1000/6-1000R
LOCATION Highland Park - Illinois Marina

JOB NAME
JOB NUMBER TC-3212
PRELIMINARY [X] FINAL [ ]
BY C.L./G.Z. DATE 9/22/78
CHECK DATE

LINE	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Site Clearing	-	LS	-	15,000
2	Dredging	-	CY	-	-
3	Excavation - Dry	-	CY	-	-
4	Breakwater - A	-	LS	-	6,365,000
5	Breakwater - B	-	LS	-	785,000
6	Breakwater - C	-	LS	-	101,000
7	Island (Fill) Construction	-	LS	-	10,632,000
8	Elevated Causeway	1000	LF	1040	1,040,000
9	Shore Protection	-	LF	-	-
10	Boat Launch Ramp	4	EA	16,000	64,000
11	Road - 40 Ft.	2650	LF	31.60	83,740
12	Road - 30 Ft.	-	LF	-	-
13	Signage	-	AL	-	25,000
14	Landscaping & Irrigation	691,500	SF	2.09	1,445,235
15	Paving	475,200	SF	.435	206,712
16	Bldg. - Administration	11,000	SF	50.54	555,940
17	Bldg. - Fuel Station	1,600	SF	41.00	65,600
18	Bldg. - Boat Storage	14,000	SF	14.25	199,500
19	Bldg. - Restroom	9 x 600	SF	56.00	302,400
20	Navigational Aids	-	LS	-	51,000
21	Power Distribution	-	LS	-	480,000
22	Water Distribution	-	LS	-	189,500
23	Sewers	-	LS	-	170,400
24	Storm Drainage	-	LS	-	106,600
25	Area Lighting/Std's	60	EA	900	54,000
26	Access Road - Change	-	LS	-	631,000
27	Dock Structures	-	LS	-	1,737,520
28	Engineering & Design	-	8%		2,024,491
	TOTAL				27,330,638
	Contingencies		10%		2,733,063
	TOTAL PROJECT COST				30,063,702

CONSTRUCTION COST ESTIMATE - SHEET NO. 1 OF 1

Direct Benefits

Income to be derived directly from the project will generally fall within the following 3 categories:

1. Marina Operations: Rental and fee income from berths, dry storage facilities, and boat launchings.

2. Ground Leases: Ground rent derived from the long-term net lease of building pads for the Yacht Club, restaurants (2), chandlery and snack bar.

3. Other: Income derived from lease of the fuel station to an operator/concessionaire, probably based upon gross sales and/or gallons of fuel dispensed; Income derived from parking fees during the 160 day boating season, net of operating expenses.

Table 14 displays a schedule of berth rental charges and annual gross income for Scheme 6-1000R. The distribution of boats according to size is based upon the table shown at the end of Section. The projected annual gross income amounts to $848,000.

Table 15 summarizes the income anticipated from the four ground lessees operating the Yacht Club, restaurants, and chandlery. Land area leased includes building pad and adjacent landscaped areas only; parking is provided in-common for the entire marina. The total land area valued at $2,231,400 would be leased on a long-term basis at an annual rate of 11 percent, with appropriate re-appraisals and rent escalations

programmed into the leases. All lease income would be net of taxes, insurance, and other expenses. Those would be totally borne by the lessee. Percentage rents may be employed in the restaurant leases if market conditions warrant. The total annual gross income is projected at $245,000.

Scheme 6-1000 provides for a total of approximately 860 parking spaces excluding those in the boat launching area. It is estimated that during the peak season, a maximum of 75 percent of the spaces held for berthed boats must be set aside for those users, or 600 spaces (75 percent of 800 permanently based boats). This leaves 260 spaces subject to fees. At an average net revenue of $5 per day, the annual income amounts to $208,000, net of expenses. It is assumed that parking will be free during the non-boating season. (approximately 205 days).

Operating costs for administration and maintenance are based on the actual costs incurred at similar marinas elsewhere and on Corps of Engineers data.

Indirect Benefits

Indirect tangible benefits will accrue as a result of the physical design of Scheme 6-1000R. These are:

1. Trapped sediment which would otherwise proceed southward along the lakeshore.

2. Reduction in losses of usable shoreline behind the island created as a part of Scheme 6-1000R.

It is estimated that 31,600 cubic yards of sediment move

into Highland Park annually along the Lake Michigan shore. As much as 60 percent of this sediment will be trapped in the northerly portion of the marina, thus preventing its continuing drift southward. Sand now purchased at local borrow sites for use along the shoreline is valued at $7 per cubic yard, Assuming that 80 percent of the trapped sediment is usable for fill purposes, the value is calculated at $106,000 annually (31,600 x 60% x 80% x $7).

The shielding of the existing shoreline by the newly created island will result in protection and preservation of this shoreline. At present, 6.74 cubic yards of earth per lineal foot of shoreline are lost each year in the Highland Park area. It is estimated that each square foot of shoreline lost represents approximately 0.5 cubic yards of material lost in the entire shoreline profile. Therefore, present annual losses are estimated to amount to 13.48 square feet of land area per lineal foot of shoreline (6.74 ÷ 0.5). The total length of the marina project is approximately 3,300 lineal feet. Using a factor of 1.25 for the wave shadow cast by the marina, the total affected shoreline would amount to about 4,100 lineal feet (3,300 x 1.25).

At an average market value of $1.50 per square foot, the total reduction in land loss due to shoreline erosion would amount to $83,000 annually (3,300 x 1.25 x 13.48 x $1.50).

Summary

The aggregate net benefit to be derived from the project is as follows:

1.	Direct Benefits (See Table 16)		$1,372,000/year
2.	Indirect Benefits		
	a. Trapped Sediment	$106,000	
	b. Shoreline Protection	83,000	
			189,000
			$1,561,000/year

If this annual net benefit was utilized to service long term (50 year) project debt at 6.87% interest, it would be sufficient to fully amortize $21,888,000 in debt. The annual debt service on the full $30,064,000 cost is $2,144,000.

With a total cost of $30,064,000, this would leave $8,176,000 to be funded from other sources or by other means. The theoretical shortfall in income for debt service, therefore, is $583,000 annually ($2,144 less $1,561 million). Because, however, the value of shoreline protection ($83,000) is an intangible benefit which cannot be directly realized in the cash flows of the project, the true cash shortfall is $666,000 annually. To eliminate or reduce this cost funding differential, there are several actions or combinations of actions which should be considered. These are:

1. Raising the rental fees for berths, dry storage spaces and launching ramps sufficient to increase annual net income by $666,000. This would amount to an increase of 50 percent in the scheduled rates, raising the average annual berth rental charge from $1,060 to $1,590.

2. Raising fees and charges for all income producing categories sufficient to increase annual net income by $666,000. This would amount to a 36.6 percent increase across the board, and may not be a feasible action.

3. Charging a one-time entry fee to all berth lessees equivalent to the annual rental charge. At the rates shown in Table 14, this would raise an additional $848,000 in capital for the project.

4. Adding additional income-producing operations within the marina project which do not require substantial additional capital cost. This could include specialty retail stores operated in the vicinity of the chandlery or the Yacht Club.

5. Reconfiguring the marina/island to increase per square foot utilization, higher density of facilities, decrease parking allocation by about 15 percent, and add to the facility/service mix items with higher income producing potential, such as launch ramps, shops, etc. This approach alone can produce an approximate 10 to 15 percent increase in revenues, and decrease initial construction cost.

6. Finally, consideration should also be given to selling berths in the form of condominium ownership of the improvements (title to the underlying land would remain with the State of Illinois). The buyer/user could be given an opportunity to purchase title to a specific berth location and ancillary improvements as an appreciating investment, whole holding title to the general improvements (utilities distribution systems, access roads and walks, restrooms, main dock structures, parking spaces, etc.) incommon with other owners as a function of their owners' association. The city could retain title to the restaurants and chandlery sites as well as the dry boat storage facilities and launching ramps. The

terms of specific agreements among the owners, the owners' association, and the city require further study and analysis; however, it is conceivable that berths could be sold for $20,000 to $30,000, thus bringing as much as $20 to $30 million of capital to the project, depending upon the number of berths withheld for transient boaters. Furthermore, each buyer could secure financing on his titled interest in the berth.

The legal, marketability and financial aspects of such an approach warrant additional study, particularly to assess whether the sale of a long-term lease subject to the public trust is feasible in the State of Illinois and constitutes "condominium". There are a number of private marinas on the west coast which are operating on this basis successfully; the desirability of placing the capital burdens of construction upon those using the facilities may make this the most acceptable financial solution.

Furthermore, consideration must be given to the inflationary factors as they affect future rental/lease income from marina facilities. If berth charges, for example, increase at a rate higher than the increase in maintenance and administration costs, then more net income will be available for debt service in the future. More importantly, ground leases with periodic rental adjustments (based either on the C.P.I. or re-appraisal of the land value), as well as percentage rents tied to gross sales, may contribute substantially to reducing any income shortfall, especially if proper planning and operation serve to make those retail operations successful.

As an example of how the $666,000 shortfall could be overcome,

TABLE 14

SCHEDULED INCOME FROM BERTH RENTALS

Boat Length	% of Total	# Berths for Permanently-Based Boats	Annual Berth Charge[1]	Scheduled Gross Annual Income
16' - 18'	8.3	66	$ 800	$ 52,800
19' - 21'	7.9	63	850	53,550
22' - 25'	10.7	86	950	81,700
26' - 29'	20.7	166	1,050	174,300
30' - 33'	21.9	175	1,100	192,500
34' - 37'	14.6	117	1,150	134,550
38' - 41'	8.3	66	1,225	80,850
42' +	7.6	61	1,275	77,775
	100.0	800[2]	Avg. $1,060	$848,025

1 Annual slip charge includes use of 1 parking space

2 800 permanently based boats in Scheme 6-1000

TABLE 15

GROUND LEASE INCOME

	Net Land Area (Sq. Ft.)[1]	Value/ Sq. Ft.[2]	Total Value
Yacht Club	67,200	$12	$ 806,400
Restaurant #2 - North	49,500	$14	693,000
Restaurant #1 - South	28,500	$12	342,000
Chandlery	30,000	$13	390,000
			$2,231,400
Rental Rate (% of Market Value)			11%
Annual Rental Income			$ 245,000

1 Excluding parking, which is provided in-common for all marina users

2 Value of building pad area only, excluding parking; fully improved, ready-to-build

TABLE 16

PRO–FORMA INCOME STATEMENT

Direct Benefits - Marina Operations		
Berth Rentals		
a. Permanently based boats [1]		$ 848,000
b. Transient boats [2]		365,000
Boat Launchings [3]		60,000
Dry Boat Storage		60,000
Total - Marina Operations		$1,333,000
Direct Benefits - Ground Lease Income		
Yacht Club		$ 88,600
Restaurant #1		76,100
Restaurant #2		37,500
Chandlery		42,800
Total - Ground Lease Income		$245,000
Direct Benefits - Other		
Fuel Station-Lease Income		$ 36,000
Parking Fees [5]		208,000
Total - Other		$244,000
TOTAL INCOME		$1,822,000
Less: Operating Costs		
Administration	$100,000	
Maintenance	350,000	
		$450,000
NET INCOME AVAILABLE FOR DEBT SERVICE		$1,372,000

[1] 80% of berths assigned to permanently-based boats; 800 boats; see schedule

[2] Based on $12 per day for 160 day season; 95% usage factor; 200 spaces

[3] 4 launch ramps; 2,500 launches per season; $6.00 per launch including all-day parking

[4] 150 spaces at $400 per season per space

[5] Based on 160 revenue-producing boating-season days per year; net of operating costs

TABLE 17

PRO–FORMA INCOME STATEMENT – AMENDED

Direct Benefits - Marina Operations	
Berth Rentals[1]	$1,667,200
Boat Launchings[2]	87,500
Dry Boat Storage[3]	75,000
Total - Marina Operations	$1,829,700
Direct Benefits - Ground Lease Income	
Yacht Club	$ 88,600
Restaurant #1	76,100
Restaurant #2	37,500
Chandlery	42,800
Specialty Retail Shops[4]	20,000
Total - Ground Lease Income	$ 265,000
Direct Benefits - Other	
Fuel Station-Lease Income	$ 40,000
Parking Fees[5]	293,300
Total - Other	$ 333,300
TOTAL INCOME	$2,428,000
Less: Operating Costs	450,000
NET INCOME AVAILABLE FOR DEBT SERVICE	$1,978,000

[1] 800 permanently-based boats at $1400 per year; 200 transient boats at $18 per day for 160-day boating season - 95% usage factor

[2] 5 launch ramps; 2500 launches per season per ramp; $7 per launch including all-day parking

[3] 150 spaces at $500 per season per space

[4] Additional pad area provided for retail specialty shops

[5] Based on 160 revenue-producing boating-season days per year; net of operating costs

Table 17 was prepared showing possible increases in rental rates and fees necessary to increase annual net income by $606,000 ($1,978,000 minus $1,372,000). The remaining $60,000 was achieved by reducing the initial capital outlay as discussed in Item 3 above by $848,000, thus reducing annual debt service by that amount. It should be noted, however, that the amended pro-forma income statement in Table 17 does not necessarily reflect rates and fees which would be acceptable in the marketplace. Rather, it is an illustration of what actions might be required to bring the project into a self-sustaining status.

5.0 Financing Alternatives

Federal and State financing alternatives are limited. Because of the marginal benefit/cost ratios (below 0.6), Federal participation is unlikely. As discussed in Section D.5.0, a 50 percent cost participation by the Federal government in certain improvements is available to those projects meeting pre-determined criteria. If Scheme 4-1000 were to qualify, the Federal share could amount to an estimated $10.5 million.

In the category of State of Illinois support, two approaches are possible. First, if the State legislature enacts a coastal zone management program in 1978, the State will be entitled to about $1.2 million annually for engineering and planning studies along the 60 mile Illinois shoreline of Lake Michigan. The State would be required to match the $1.2 million in Federal funds with $0.3 million in State funds. The coastal zone management program office would administer and dispense the funds available. If a program is enacted and implemented, funds could be made available to the Highland Park project for engineering and

planning activities. The local agency would likely be required to match with its own funds 20 percent of the State/Federal contribution. Because of the limited funds available for the entire Lake Michigan shoreline, however, it is unlikely that more than $100,000 of State/Federal support would be available to the Highland Park project.

Second, the Illinois legislature could financially assist the project through a special appropriation, either bonding through the Capital Development Board of appropriating funds from general revenues. This could be sought at the time the General Assembly is called upon to authorize the use of public lands for construction of the marina itself.

6.0 Environmental Compatibility Scheme 6-1000R

Consideration for environmental impacts and their magnitude and importance for the island marina concept was discussed in detail in Section D.6.0. In general, the same aspects pertain to the 6-1000R scheme. Considering the overall magnitude of the project, the duration of its construction/implementation and the various associated potential long-term effects, the project in its proposed form presents a relatively moderate impact.

In this section, we will discuss briefly the major impacts/compatibility unique to the 6-1000R scheme, and some suggested mitigation measures.

The following environmental factors (in order of importance) are considered as significant:

1. Community Character
2. Economics, Socioeconomics

3. Traffic
4. Beach Erosion
5. Water Quality

The following brief discussion of each of the above listed factors will deal with the principal issues highlighting the major concerns.

1. Community Character Impacts

Without doubt, changes will take place in the general community character of Highland Park. A small boat recreational harbor of this capacity will attract boat owners, fishermen and other marina/waterfront users, some directly from the Chicago metropolitan area. Impacts ill be felt principally on holiday weekends during the oating/lake use season.

ow these changes are perceived and dealt with will depend heavily on the overall community/area acceptance and perception of the project. It is suggested that a public information program be initiated to keep everyone informed on all development activities in a straightforward, open and positive manner. Overall impact important but moderate.

2. Economic/Socioeconomic Impacts

Economic viability, i.e., self-liquidating long-term operation of the project is an essential characteristic of the marina development. Given that this goal is met, community economic impacts will be generally positive, providing additional tax base, employment and new business opportunities.

However, if the project is not structured to operate on an economically self-sustaining basis and has to be supported by local tax revenue, negative impacts of various types and magnitude can be anticipated. The most significant negative impact will be lack of area resident support for its activities.

A careful marketing analysis should be undertaken prior to its implementation phase. All phases of the operation economics should be finetuned to a realistic revenue base.

3. Traffic Impacts

Magnitude of traffic impacts is analyzed separately in this report - Appendix 5.0. However, a general assessment in selection of the access route indicates that traffic during peak user times will create some adverse impacts. Specific nature and magnitude of these impacts is difficult to estimate at this time. The carrying capacity of the major streets and roads leading to the site (Central Park Beach) is adequate to accommodate the additional anticipated traffic, given necessary modifications to the Central Avenue (near Lake Avenue) bridge structure and widening of the terminus of Park Avenue near the Water Works.

Proper signalization changes in the downtown area will also help mitigate these potential traffic impacts. Overall impact - moderate.

4. Beach Erosion Effects

As discussed earlier in the study, the general effect of the island marina will be to provide a wide - 4100

lineal foot wave shadow on the shore, thus helping significantly to decrease current accelerating beach erosion processes. Since it is anticipated that some 60 percent of the estimated 31,600 cubic yards of sediment moving into Highland Park beach annually can be trapped, it is a significant economic and environmental benefit to the community. Other alongshore effects are minimal.

5. Water Quality Impacts

Impacts on water quality will be significant during the construction of the marina since the construction placement of rip-rap and fill will generate disturbance of the lake bottom. Mitigation measures should include special methods for placement of rock and construction of protective structures near the water intakes at the beginning of the construction cycle.

Impacts from seasonal operation of the marina will be moderate and can be easily mitigated through housekeeping and operational controls.

Other environmental impacts, although significant in their own right, have a lesser overall potential for permanent change or damage to the area, and in most cases produce effects of minimal significance.

CONCLUSIONS

H. CONCLUSIONS

Based on the engineering, design and feasibility analysis conducted for the Highland Park safe water recreational harbor at the Central Park location, the following conclusions can be drawn:

1. It is environmentally and functionally feasible to construct and operate a small boat recreational harbor at the Central Park location. Its configuration should be an offshore island, shore connnected concepts were found not to be feasible at this location.

2. The size of the marina, for economical and successful operation, should exceed 1000 boat/slip capacity. All moorings should be slip moorings. It is not recommended that the marina be constructed incrementally.

3. None of the candidate marina schemes qualify for Federal cost sharing, because of their extensive protective and navigational works. It is unlikely that any size and configuration marina would meet cost sharing criteria at this location.

4. To operate the marina as an economical, self-sustaining entity, determination of provided services mix is critical. Careful selection should be made to establish the most profitable operational mix of user services prior to design and development.

   A services marketing study should be undertaken to optimize the mix of community and commercial services selected.

5. The proposed Scheme 6-1000R marina, although not completely self-sustaining in its final configuration and under the operational criteria used, can be made to operate economically if proper facility mix adjustments are made and/or financing is based on condominium slip ownership basis. This assumes no state or Federal cost sharing participation.

6. Environmentally the proposed 6-1000R marina scheme is compatible with the site and community area, with most negative impacts in the small to moderate range. Magnitudes of positive impacts were not assessed due to their highly subjective nature.

7. The proposed marina Scheme 6-1000R will provide a substantial benefit to the community as a shore erosion control device - protecting approximately 4,100 feet of beach in its wave shadow.

8. Scheme 6-1000R marina, because of its detached offshore location, will have minimal noise impact on riparian property owners in the area.

9. A site location evaluation task should be undertaken to establish precisely the best location for the marina, minimizing potential for traffic, visual, noise and general environmental impacts on the community.

   The analysis undertaken for the Traffic Impact Study in the Appendix of this report shows some of the traffic impact magnitudes for the Central Park and Walker Avenue site areas, but do not address other aspects of potential site locations.

Above conclusions summarize the general findings of this engineering feasibility study and define the safe water recreational harbor potential within the limits of the study. More definitive and quantitative answers to some of the questions raised will result from subsequent detailed planning/engineering design work, marketing analysis, site geologic studies and environmental impact assessment.

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Seasonal Depth Distribution of Fish in Southeastern Lake Michigan, Bureau of Commercial Fisheries Biological Laboratory, Ann Arbor, Michigan, June 1968

32. Williams-Kuebelbeck and Associates, Inc., Uniform Guidelines for Assessing the Equity of Anchorage Rates at Marina Del Ray, 1975, County of Los Angeles, Department of Small Craft Harbors

2.0 List of Contacts

1. Mr. George R. Bonnett, P.E.
   Director of Public Works
   City of Highland Park, Lake Co. Illinois
   1707 St. Johns Avenue
   Highland Park, Illinois 60035

2. Ms. Donna Christman
   Director
   Illinois Department of Transportation
   Coastal Zone Management Program

3. Mr. Charles Collinson
   Illinois State Geological Survey
   Urband, Illinois 61820

4. Commonwealth Edison Company
   Chicago, Illinois

5. Department of Transportation
   2300 South Dirksen Parkway
   Springfield, Illinois 62706

6. Division of Fisheries
   Department of Conservation
   100 East Washington
   Springfield, Illinois 62706

7. EPA, Illinois
   2200 Churchill Road
   Springfield, Illinois 62706

8. Mr. Dan Injerd
   Coastal Resource Planner
   Illinois Department of Transportation
   Division of Water Resources
   300 N. State Street
   Chicago, Illinois 60610

9. International Marine Expositions, Inc.
   Marketing Research Department

10. Mr. Stevel Laue
    Northeastern Illinois Planning Commission

11. Mr. Ernest W. Nance
    Director
    Park District Highland Park
    1801 Sunset Road
    Highland Park, Illinois 60035

12. Mr. Larry Rice
    City Manager
    City of Highland Park, Lake Co. Illinois
    1707 St. Johns Avenue
    Highland Park, Illinois 60035

13. Mrs. Rossi
    Lake County Regional Planning Commission

14. U.S. Department of Agriculture
    Soil Conservation Service
    Washington, D.C.

15. U.S. EPA
2300 South Dearborn Street
Chicago, Illinois 60604

APPENDIX

J. APPENDIX

1.0 Marina Feasibility Study Questionnaire Results

As part of the marina feasibility study work, a questionnaire was prepared to obtain some general public opinions on different aspects of the proposed project. Copies of these questionnaires were distributed at the initial public meetings, May 10, 1978 and September 6, 1978, in Highland Park. The results, along with the questionnaire form are attached in this appendix.

75 RESPONSES, SEPTEMBER 6, 1978

HIGHLAND PARK RECREATIONAL

MARINA FEASIBILITY STUDY

QUESTIONARE

PREPARED BY ILLINOIS DEPARTMENT OF TRANSPORTATION
AND TETRA TECH, INC. - CONSULTING ENGINEERS

In order to reflect more accurately the wishes and intent of the area residents in the Highland Park marina feasibility study answers to a number of questions regarding the overall planning concept will provide substantial assistance.

Please answer the following:

1. Are you a riparian property owner in Highland Park? — Yes 17 No 58

2. Are you a boat owner/user? — Yes 64 No 11

3. How far do you live from Park Ave Beach? (circle one)
   - 0-5 miles - 68
   - 6-10 miles - 6
   - 11-12 miles - 1
   - 20-60 miles
   - Further

4. Would you support a well planned development of a small boat marina facility at the Park Ave Beach location? — Yes 60 No 11

5. What boat capacity marina/safe water harbor would you consider most compatible with the area? (circle one)
   - 40 boats-1
   - 50 boats-1
   - 250 boats-14
   - 500 boats-27
   - 1000 boats-20
   - Smaller boat -1
   - Not sure-2
   - No Answer-3

6. If you are opposed to the development of a marina facility, what are your principal concerns? (indicate two)

- continued on next page -

10 - a. Increased traffic

9 - b. Increased noise and congestion

4 - c. Visual/aesthetic degradation

8 - d. Change in community character

5 - e. Increased crime/vandalism

10 - f. Downstream shoreline impact

3 - g. Other _____

57 - h. No Answer

7. If you support a marina development which would you consider the most beneficial aspects to the area? (indicate two)

57 - a. Availability of boating facilities

17 - b. Economic impact on community/area

29 - c. Shoreline enhancement

2 - d. Other _____

8 - e. No Answer

8. If you support a marina development which of the following facility elements would you like to see incorporated? (circle as many as appropriate and rate them numerically in order of importance)

a. Restaurant/dining facilities

b. Snack bar

c. Boat sales/Boat rentals

d. On site boat repairs

E ATTACHED

ATRIX

e. Limited related commercial, shop facilities

f. Swimming beach

g. Bait shop

h. Boating and fishing accessary shop

i. Boat fueling/Service/Maintenance facility

j. Camping/Picnicking facility

k. Fishing piers

l. Boat storage facility

m. Other _____

9. If the marina would be designed with remote parking, (using the commuter lot in town), and a shuttle bus for transportation, would you as a user consider it: (circle one)

18 - a. An acceptable solution

28 - b. A marginal solution

20 - c. An unacceptable solution

ITEM	ORDER OF IMPORTANCE												
	1	2	3	4	5	6	7	8	9	10	11	12	13
A	2	4	9	7	3	1	1						
B		2	4	3		5	3	1					
C			2	1	1		2	1					
D		11	6	6	2								
E	1	2	1		3	1	1						
F	1	3	4	3	6	3		1	1				
G				2			2	1	1	1		1	
H		1	4	3	3	1	1		1				
I	21	8	2	1	2	2							
J		3	1		1	1	2	2	1		1		
K			2		2	4	1			2			
L	11	5	3	4	2	1	1	2			1		
M/Other:	3			1									
Boat Yacht Club									1				
Yacht Club Facilities Top Priority													1

2.0 Public Response Letters

Enclosed are copies of letters received by the City of Highland Park and the Illinois Department of Transportation from area residents in response to the marina feasibility study work and associated public information meetings.

E. MONTFORD FUCIK
57 SOUTH DEERE PARK DRIVE HIGHLAND PARK, ILLINOIS 60035

September 7, 1978

Ms. Donna Christman
Illinois Department of Transportation
Division of Water Resources
300 North State Street/Room 1010
Chicago, IL 60610

Subject: Highland Park Harbor Study

Dear Ms. Christman:

I was very interested in the meeting which was held at the Recreational Center in Highland Park on Wednesday evening, September 6th. I left before I was able to express my preference concerning the three schemes that were presented by Tetra Tech. It appears to me that the Scheme 6-1000 should be the scheme selected for further study. My reasoning for this selection is that, first, this scheme provides the possibility of starting with a 500 slip harbor and expanding it later if the need becomes evident. If Scheme 6-500 were to be adopted I would suggest that it be moved out into the lake about the same distance that Scheme 4-1000 was. This would provide a better chance for sand to pass inboard of the harbor and thus would reduce the annual dredging requirements.

As you probably remember, I own land on the lake at the south end of Highland Park and am therefore very sensitive to any interruption of the littoral drift to the north of my property. One provision which probably should be made in any final harbor solution would be that the owners of the harbor be required to maintain the lake bottom contour at exactly the same levels as they existed prior to the development of the harbor. In this way assurance could be given that all of the littoral drift would indeed be bypassed and none would be left to accrete either upstream of the harbor or between the harbor and the shoreline.

I am sure you were pleased with the interest shown at the meeting last night!

Yours very truly,

cc: Mr. Ernie Nance
Director,
Park District of
Highland Park

September 8, 1978

Mr. Ernie Nance, Director
Highland Park District
1801 Sunset Road
Highland Park, Illinois 60035

Dear Mr. Nance:

This letter is to register my interest in the Feasability Study for a Small Boat Recreational Harbor. I am sorry to report that I will be unable to attend the hearing.

As a user of the present facility, I can say that the area is in serious need of a protective harbor. This Would facilitate the safer use of the area, reduce the damage of boats, and certainly reduce the constant errosion of the bank.

Please be advised that I am in favor of whatever improvement can be made, and conform to acceptability with the environment, the social aspect, and can be economically feasible. I would appreciate being advised of the various happenings.

Sincerely,

Kenneth Kieselburg

Kenneth Kieselburg
11800 Ventura Blvd.
Rockford, Illinois 61111

KK:hf

cc: Donna Christman
Program Mgr. Ill.Coastal Zone Mgmt.Program
300 N. State St.
Room 1010
Chicago, Ill.,60610

Illinois

1401 Waverly Road
Highland Park 60035

September 14, 1978

Illinois Department of Transportation
Division of Water Resources
300 North State Street
Room 1010
Chicago, Illinois 60610

Gentlemen:

In reference to the proposed harbor in Highland Park, Illinois, on the basis of the enormous cost and the potential for erosion of the properties to the South of Central Avenue, I would like to go on record as opposing the harbor.

Sincerely,

John M. LeBolt

JML:bas

Highland Park News
Sept. 21, 1978

Don't want harbor

HIGHLAND PARK — The proposed Highland Park Island Marina would alter the nature of life for every citizen in Highland Park. In the Tetra Tech proposal the favored 1,000 boat marina was referred to as the "regional" plan: it is intended to serve a larger area than just Highland Park itself. It is questionable whether such a large harbor is appropriate to the needs of Highland Park alone, if this is the plan. There is some doubt as to which purpose the harbor is supposed to serve.

At any rate, with 1,000 slips the marina would be larger than any harbor in Chicago. Most harbors in the Chicago area have roughly 200 slips. If federal money is used in its construction, the slips would have to be available to the general public, with no

(Continued on page 21)

• Letters Continued from page 16

preference given to residents of Highland Park. As there is no harbor of any sort between Waukegan and Wilmette, this plan would draw people from surrounding communities who would use Highland Park as a recreational center. There would be much increased traffic, noise, and pollution throughout Highland Park on every summer weekend as cars trailing boats would drive to the marina to fill the 900 available parking spaces, and other parking lots might fill with people who would take shuttle buses to their boats kept in the harbor. We would live in more a "tourist" town and less the peaceful, relatively clean and quiet place we have now. Tourist activity brings vandalism, and is destructive to the peaceful style of life which attracted most Highland Park residents in the first place.

By building such a large harbor we would bring all its attendant environmental stresses into focus right in our own neighborhoods. In addition to increased car traffic and pollution, the majority of the boats using the harbor would be motorboats with their attendant noise and their own emission of pollution, all of which would help form ozone, which Highland Park seems to have been relatively free of in the past.

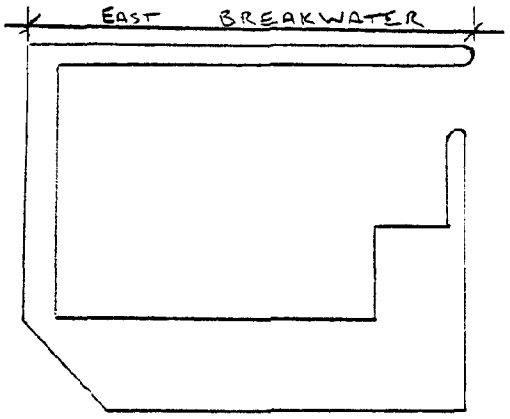
There is great pressure for boat storage, harbor and launching facilities in the North Shore and its western neighbors. However, the proposed harbors at Zion and Illinois State Beach Park would alleviate the problem, if built. Smaller harbors could serve the various towns on the North Shore rather than concentrating this influx of cars, motorboats and people in the middle of Highland Park. I suggest that interested citizens attend the November meeting concerning this matter.

Mary Millard
1623 Sylvester Pl.

3.0 Sample Calculations - Design and Cost Estimate for East Breakwater of Scheme 4-1000

Explanatory Note

The calculations which follow for design of the east breakwater of Scheme 4-1000 are based primarily upon the recommendations of the U.S. Army Corps of Engineers Shore Protection Manual (hereafter abbreviated SPM). That portion of breakwater under consideration is as follows:



Design and cost calculations for the remaining protective structures of the various marina schemes are analogous.

Depth of Water @ Structure Toe

Based on "Hydrography Compilation Map", depths are as follows:

DHW

NE corner	d_s = 23.5'
SE corner	d_s = 24.0'
SE tip (entrance)	d_s = 23.5'
Assumed	d_s = 23.5'

DLW

Assumed	d_s = 19.2'

" " " Design Wave " " "

Design Wave @ DHW

Given: H_o = 12'
T = 8 sec
Direction = NE ; α_o = 15°
d_s = 23.5'

Calculate K_r:

From Wiegel, p. 160, $K_r = 1$

Calculate K_s:

From Wiegel, p. 516

for $^d/L_o = 0.0717$, $K_s = 0.9681$

Calculate H @ Structure:

$$H = H_o \cdot K_r \cdot K_s$$

$$H = (12.0')(1)(0.9681)$$

$$H = 11.6 \text{ ft}$$

Design Wave @ DLW

Given: $H_o = 12'$

$T = 8$ sec

$\alpha_o = 15°$

$d_s = 19.2'$

Calculate K_r:

From Wiegel, p. 160, $K_r = 1.0$

Calculate K_s:

From Wiegel, p. 516:

for $^d/L_o = 0.0586$, $K_s = 0.9907$

Calculate H @ Structure:

$$H = H_o \cdot K_r \cdot K_s$$

$$= (12.0)(1.0)(0.9969)$$

$$= 11.96 \text{ ft - say } 12 \text{ ft}$$

Design Wave—Depth of Breaking

Given: $H_o' = 12.0'$

$T = 8$ sec

$$m = \frac{2'}{525'} = 0.004$$

SPM Fig 7-3:

for $\frac{H_o'}{gT^2} = \frac{12}{(32.2)(64)} = 0.0058$,

$H_b/H_o' \simeq 1.0$ (extrapolation) $\therefore H_b = H_o' = 12.0'$

SPM Fig 7-2:

for $H_b/gT^2 = 0.0058$

$(d_b/H_b)_{max} = 1.53$

$(d_b/H_b)_{min} = 1.25$

hence: $(d_b)_{max} = 18.4'$ $(d_b)_{min} = 15.0'$

$\therefore$ Design Wave will not break on outer BW leg.
Design Wave = 12.0' unbroken

Determination of Seaward Breakwater Crest Elevation

Calculate Runup

Method: SPM Section 7-21

Given: Design Wave: $H_o' = 12'$

$T = 8$ sec

Design Water Level: DHW

$d_s = 23.5'$

Structure: Impermeable Rip-Rap; 1 on 2 Scope ($\cot\theta = 2$)

---

1) Calculate Runup on Smooth, Impermeable Slope of 1 on 2

$d_s/H_o' = \frac{23.5}{12} \simeq 2.0$

$H_o'/gT^2 = 12/(32.2)(64) = 0.0058$

From SPM Fig 7-11: $R/H_o' = 2.4$

$\therefore (R)_{uncorrected} = 28.8'$

2) Correct Runup for Scale Effects

$\cot\theta = 2.0$ $\quad H_o' = 12.0'$

From SPM Fig 7-13: $K = 1.19$

$\therefore (R)_{corrected} = (1.19)(28.8) = 34.3'$

3) Correct Runup for Effect of Rubble

Direct correction factor not possible; ∴use % correction for 1 on 1.5 slope and apply to 1 on 2 slope.

a) Calculate Runup on Smooth, Impermeable 1 on 1.5 Slope

$d_s/H_o' = 2.0$ $\quad\quad$ $\cot\theta = 1.5$

$H_o'/gT^2 = 0.0058$

From SPM Fig 7-11: $[R/H_o']_{smooth} = 2.5$

b) Calculate Runup on Impermeable Rubble 1 on 1.5 Slope

$d_s/H_o' = 2.0$ $\quad\quad$ $\cot\theta = 1.5$

$H_o'/gT^2 = 0.0058$

From SPM Fig 7-15: $[R/H_o']_{rubble} = 1.0$

c) Runup on 1 on 2, Rubble Scope

$$[R]_{\substack{1:2 \\ rubble}} = [R]_{\substack{1:2 \\ smooth}} \frac{[R]_{1:1.5\ rubble}}{[R]_{1:1.5\ smooth}}$$

$$= 34.3'\left(\frac{1.0}{2.5}\right)$$

$$= (34.3')(0.40) = 13.7 \text{ ft}$$

Set Crest Elevation

Allow 4' overtopping @ DHW

Max Runup = 13.7 ft

$\therefore$ Crest Height = (13.7-4) = 9.7' above DHW

= 14 ft LWD

Armor Stone Required

Use Hudson's Equation (SPM p. 7-169)

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

Given: H = 12.0 ft

Assume: Armor Stone is rough angular granite, randomly placed 2 layers thick @ 1 on 2 slope

Assume: $w_r = 165$ lb/ft^3

Hence: $\cot\theta = 2$

$w_r = 165$ lb/ft^3

$w_w = 62.4$ lb/ft^3

$S_r = w_r/w_w = 2.64$

Assume also minor overtopping only. Hence, K_D for non-breaking wave applies. From SPM Table 7-6: $K_D = 4.0$

Hence: W = 8018# - say W = 5 tons

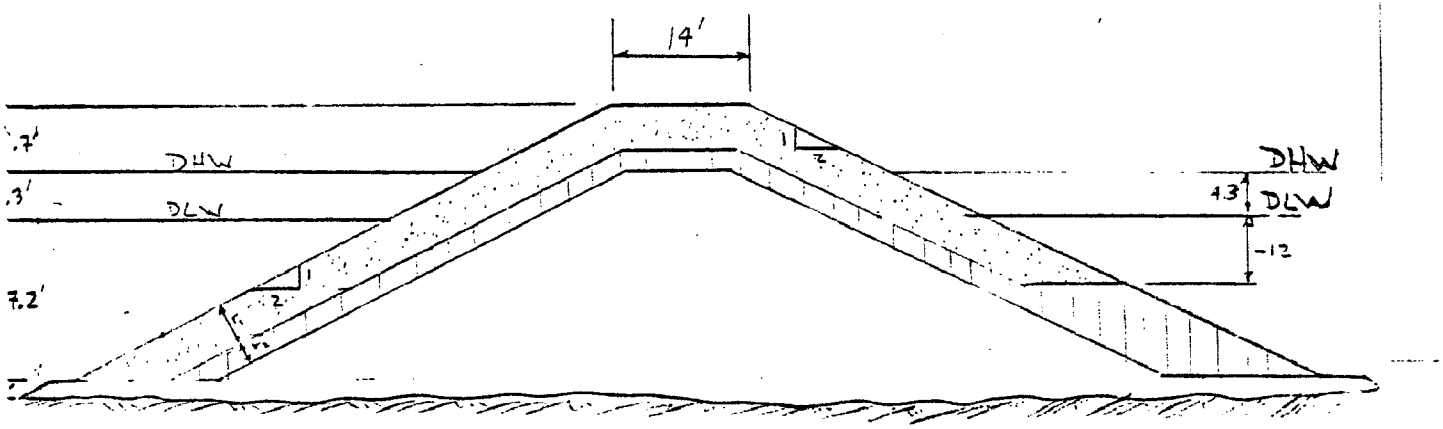
Gradation: .75 to 1.25 W, or 3.75 to 6.25 tons

Seaward Breakwater Section

Given: Non-Breaking Wave H =12.0'

Moderate Overtopping

d_s = 23.5' DHW = 19.2' DLW



(After SPM Fig 7-95)

	Size	Gradation
= Armor Units	W = 5 tons	125% to 75%
= Underlayer	W /10 = 1000#	130% to 70%
= Core	W/200 to W/6000 = 50# to 2#	170% to 30%

Cross-Sectional Areas

A) Armor

Thickness (SPM Eq. 7-108):

$$r = nK\Delta \left(\frac{W}{Wr} \right)^{1/3}$$

$$r = (2)\ (1.15) \left(\frac{10,000}{165} \right)^{1/3} = \underline{9.0 \text{ ft.}}$$

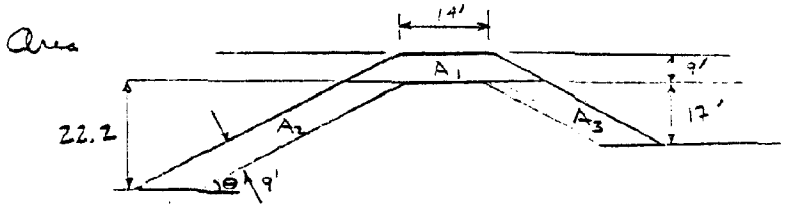
Crest Width (SPM Eq. 7-107)

Make crest 3 armor stones wide for moderate overtopping conditions:

$$B = nK\Delta \left(\frac{W}{Wr} \right)^{1/3}$$

$$B = (3)\ (1.15) \left(\frac{10,000}{165} \right)^{1/3} = 13.55 \text{ ft.}$$

Say 14 ft.



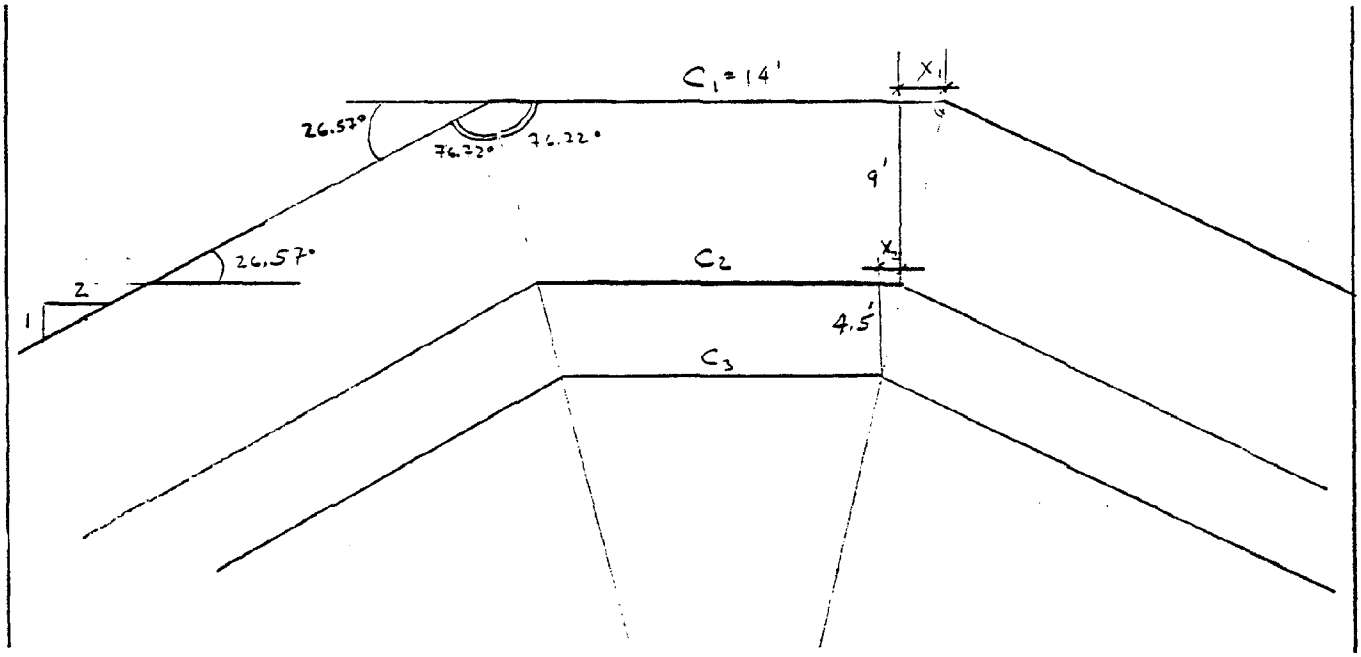
$$A_1 = \frac{9}{2}\ (14' + 14' + 18' + 18') = 288 \text{ ft}^2$$

$$A_2 = \frac{9}{\sin\theta}\ (22.2) = 9\sqrt{5}\ (22.2) = 447 \text{ ft}^2$$

$$A_3 = \frac{9}{\sin\theta}\ (17) = 9\sqrt{5}\ (17) = 342 \text{ ft}^2$$

$$\sum = 1077 \text{ ft}^2$$

Crest Detail



$$\text{Tan } 76.72° = \frac{9'}{X_1}$$

$$X_1 = \frac{9'}{\text{Tan } 76.72°} = 2.125'$$

$\therefore$ $C_2 = 14' - (2.125')\ (2) = 9.75$ ft.

$$\text{Tan } 76.72° = \frac{4.5'}{X_2}$$

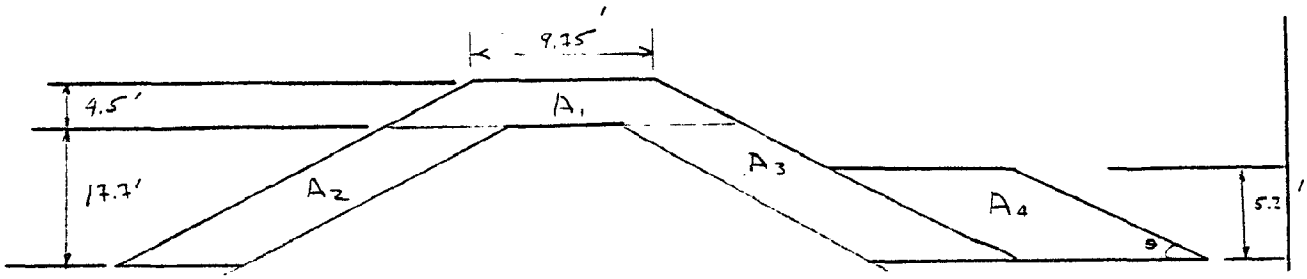
$$X_2 = \frac{4.5'}{\text{Tan } 76.72°} = 1.062'$$

$\therefore$ $C_3 = (9.75') - (2)\ (1.062) = 7.625$ ft.

B) Underlayer

Thickness $r = n K_{\Delta} \left(\frac{W}{Wr}\right)^{1/3}$

$r = (2)\ (1.15) \left(\frac{1000}{165}\right)^{1/3} = 4.2$ Say 4.5 ft



$A_1 = \left(\frac{4.5}{2}\right)\ (9.75 + 9.75 + 9 + 9) = 84.38$

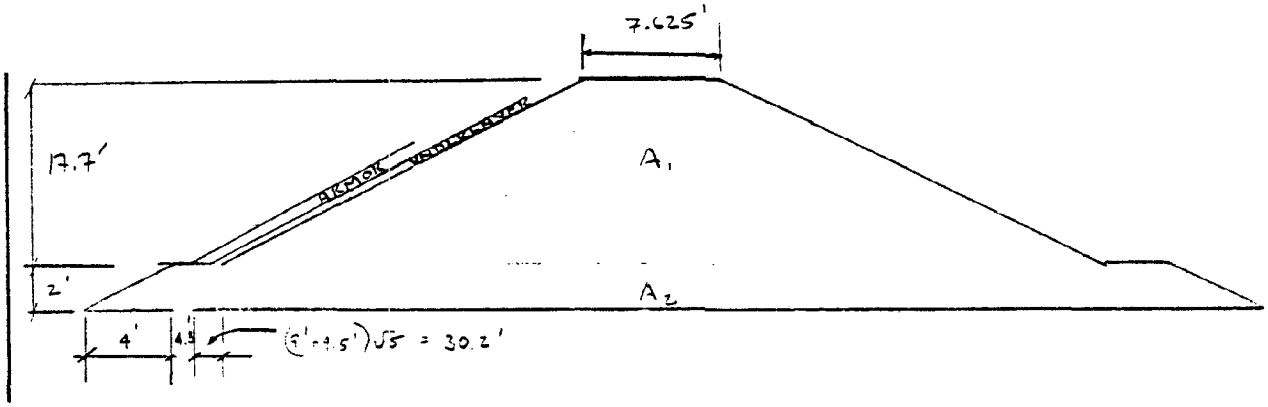
$A_2 = (\sqrt{5})\ (4.5)\ (17.7) = 178.10$

$A_3 = A_2 = 178.10$

$A_4 = \frac{9}{\sin\theta}\ (5.2) = (9\sqrt{5})\ (5.2) = 104.65$

$\sum = 545 ft^2$

C) Core

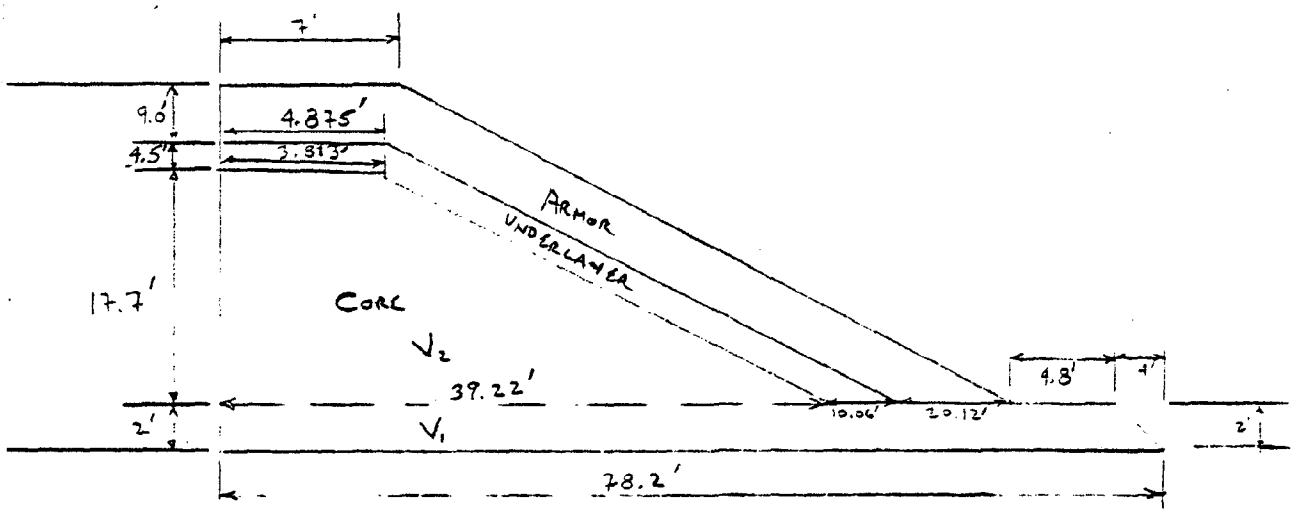


$$A_1 = \left(\frac{17.7}{2}\right) \quad [7.625 + 7.625 + (4)\ (17.7)] = 761.54\ ft^2$$

$$A_2 = \left(\frac{2}{2}\right) \quad \{2[(17.7)\ (4) + 7.625 + (2)\ (35)] + 4(2)]\} = 304.85\ ft^2$$

$$\sum = 1066\ ft^2$$

Head Section



For half of truncated cone $V = (1/2)(1/3)\ \Pi\ (h)(R_1^{\ 2} + R_2^{\ 2} + R_1 R_2)$

Core: $V_1 = \frac{\Pi}{6}(2)\ [(78.2)^2 + (74.2)^2 + (78.2)(74.2)] = 18,245.66$

$V_2 = \frac{\Pi}{6}(17.7)\ [(3.813)^2 + (39.22)^2 + (3.813)(39.22)] =$

$15,776.34$

$V_{Core} = 34,022\ ft^3$

Underlayer: $V_{Underlayer} = \frac{\Pi}{6}\ (22.2)\ [(4.875)^2 + (49.28)^2 + (4.875)\ (49.28)] - V_2$

$V_{underlayer} = 15,521\ ft^3$

Armor: $V_{Armor} = \frac{\Pi}{6}\ (31.2)\ [(7)^2 + (69.4)^2 + (7 \times 69.4)] - V_2 - V_{Underlayer}$

$V_{Armor} = 56,121\ ft^3$

VOLUME AND COST ESTIMATE

ITEM	(FT^2) X-SECTIONAL AREA	(FT) LENGTH	(YD^3) TOTAL VOLUME	(%) POROSITY	TONS	($/TON) UNIT COST	($) COST
I. ARMOR STONE							
A. Seaward Arm	1,077	2,700	107,700				
B. Head	-	-	2,079				
			109,779	37	154,229	25	3,855,713
II. UNDERLAYER							
A. Seaward Arm	545	2,700	54,500				
B. Head	-	-	575				
			55,075	37	77,375	18	1,392,748
III. CORE							
A. Seaward Arm	1,066	2,700	106,600				
B. Head	-	-	1,260				
			107,860	25	180,396	12	2,164,750

GRAND TOTAL $7,413,000

($2746/LF)

NOTES:

1. Porosities from SPM Table 7-9 and from personal communication w/U.S. Army Corps of Engineers
2. Tons = (Total Volume)(1 - Porosity)$\left(\frac{165\#}{ft^3}\right)\left(\frac{27\ ft^3}{yd^3}\right)\left(\frac{1\ ton}{2000\#}\right)$ = (Total Volume)(1 - P)(2.23)
3. Unit costs based on personal communication with Chicago District, U.S. Army Corps of Engineers

4.0 List of Symbols

B = Breakwater crest width (ft.)

d = Depth of water (ft.)

d_b = Depth of breaking (ft.)

d_s = Depth of water at structure toe (ft.)

DHW = Design high water level

DLW = Design low water level

g = Acceleration due to gravity (ft/sec^2)

H = Design wave height at structure site (ft.)

H_o = Deepwater significant wave height (ft.)

H_o' = Unrefracted deepwater significant wave height (ft.)

K = Runup correction factor

K_Δ = Layer coefficient

K_D = Stability coefficient

K_r = Refraction coefficient

K_s = Shoaling coefficient

L_o = Deepwater wave length (ft.)

m = Bottom shape at structure site

n = Number of stones or stone layers

R = Wave runup above still water level (ft.)

r = Stone layer thickness (ft.)

S_r = Specific gravity of armor unit relative to the water at the structure ($S_r = w_r / w_w$)

T = Significant wave period (sec)

V = Volume (ft^3)

W = Stone weight (#)

w_r = Unit weight of stone ($\#/ft^3$)

w_s = Unit weight of water at structure site ($\#/ft^3$)

L_o = Angle between deepwater wave crest and bottom contours at structure site (degrees)

Θ = Angle of structure slope measured from horizontal (degrees)

5.0 TRAFFIC IMPACT STUDY

General Approach

As an addendum to the Small Boat Recreational Harbor Facility Study for Highland Park, this traffic impact analysis is undertaken to ascertain the overall incremental increase in traffic generated by the project; and essential differences in impact in locating the marina at two alternate site locations at the foot of Central Avenue near the Water Works and at the foot of Walker Avenue.

In order to establish the magnitude of the principal impacts, three separate areas of concern were analyzed:

1. Incremental increases in average daily traffic counts on affected streets and highways.
2. General anticipated economic impacts of traffic in the area - specifically within city limits of Highland Park.
3. Physical and planning considerations for alternate site access routes.

Methodology for the above outlined analysis involved comparison of the proposed Highland Park Marina to already known and quantified impacts of other recently constructed marinas of approximately equal size and service mix. Extrapolations were made in traffic generation, traffic timing and overall economic effects, with appropriate adjustments for areas where service mix and geographical location would create differences.

For both site locations, it was assumed that the physical

configuration, service mix and size would be that of the proposed Scheme 6-1000R - island marina, 1000 boat capacity.

Traffic Analysis

The volume and impact of new vehicular traffic generated by the proposed marina was determined, as indicated before, for the two alternate marina locations, i.e., the Waterworks site at the foot of Central Avenue and the northern site at the foot of Walker Avenue. See Figure 26, 1977 Traffic Map of the Area and Site Locations. In both cases, certain possible route patterns were selected for traffic to and from the facilities, based upon existing road patterns and capacities, distance and accessibility to Route 41 and other arterial streets and highways, and the likely geographic distribution of the boat users' areas of origin.

Areas of Marina User Origin

The demand for boating facilities was discussed in Section B.4 of this report. The local Highland Park-Wilmette market projections developed by the Corps of Engineers indicate a total unsatisfied demand in the area for 300 berths and moorings in 1980, increasing to 430 in 1990. This includes the demand by residents of inland counties whose most feasible or most desirable berth location would be in the Highland Park-Wilmette region. Therefore, it cannot be assumed that 300 berths and moorings are being sought by residents of Highland Park alone. Without further detailed analysis of the magnitude and type of demand for boating facilities by residents of the City of Highland Park, it is not possible to precisely predict that impact. However, for purposes of the traffic impact analysis, it was assumed that approximately one-half

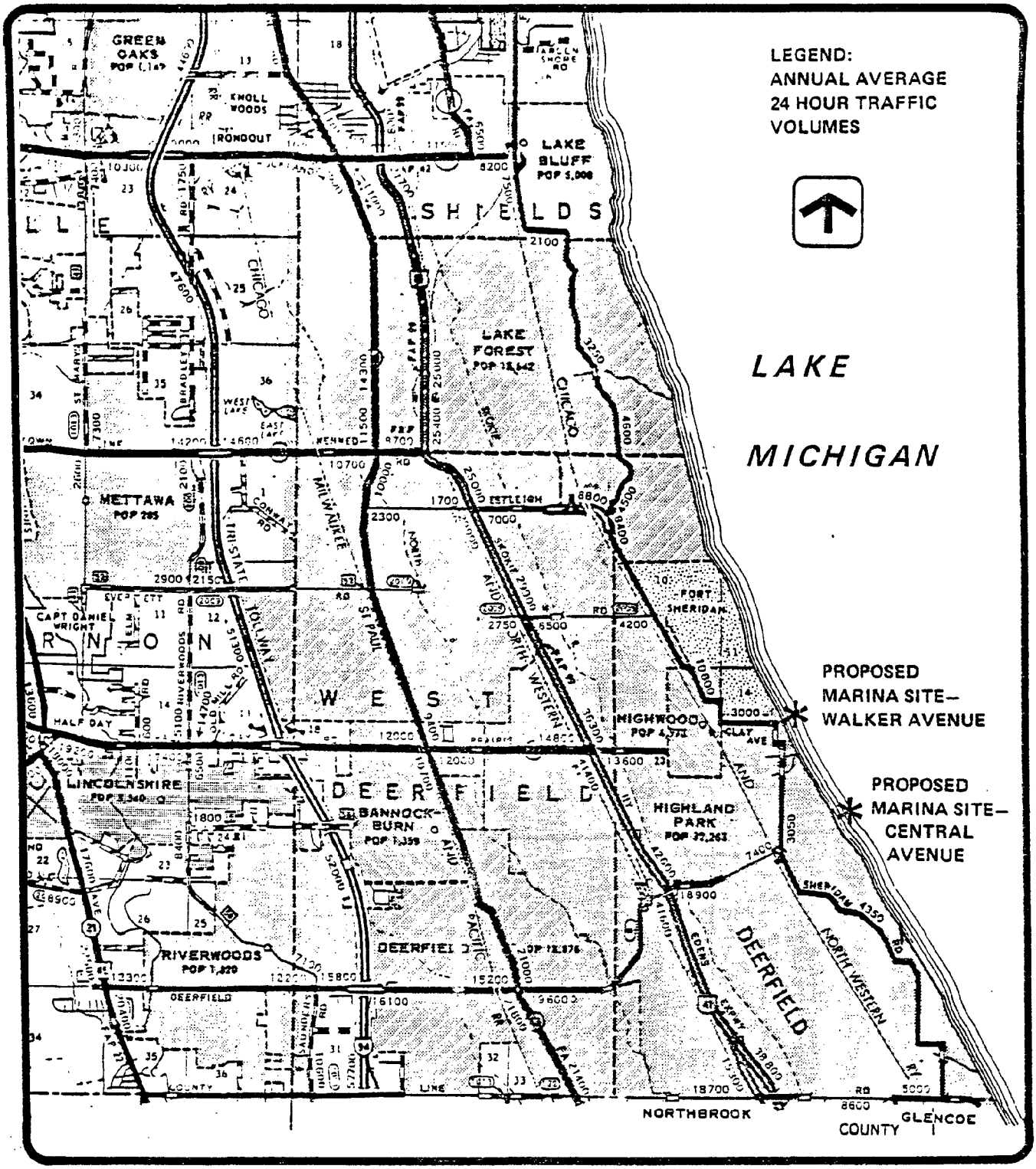


FIGURE 26 1977 TRAFFIC MAP OF GENERAL AREA UNDER CONSIDERATION

of the total local demand could be attributed to residents of the city. Therefore, approximately 150 berths would be leased by residents in 1980, increasing to 215 in 1990. This also assumes, of course, that first priority would be given to residents of Highland Park in the leasing program.

The figures of 150 to 215 permanent berths are consistent with the figures mentioned in the September, 1975 Annual Report of the Highland Park Lake Front Commission. In that report, an informal survey reported that 200 signatures were gathered on a petition from those owning or wishing to own boats in Highland Park. Presumably, these persons would be willing to pay to lease space in a local marina.

The balance of the 800 permanently based boats, or 585 to 650 boats, would be owned by non-residents in the surrounding communities and counties. The Corps of Engineers' study[1] indicates that the greatest unsatisfied demand exists south of the Highland Park-Wilmette region. Approximately 79 percent of the demand originates in the south while 21 percent originates to the north up to the state line. The geographic profile, then, may be displayed as shown in Figure 27.

Traffic Generation

A recent survey of comparable marinas revealed a fairly consistent pattern of traffic activity during the boating season. After taking into account the many variables in marine siting and design, it was determined that the average daily traffic (ADT) generated by a recreational marina ranged from 6 to 8 trips per permanently assigned berth. This figure allows for a nominal amount of traffic generated by the ancillary operations and activities within the marina facility (restaurants,

[1] U.S. Army Corps of Engineers, 1974, Lake Michigan Regional Boating Survey and Analysis, January, 1974

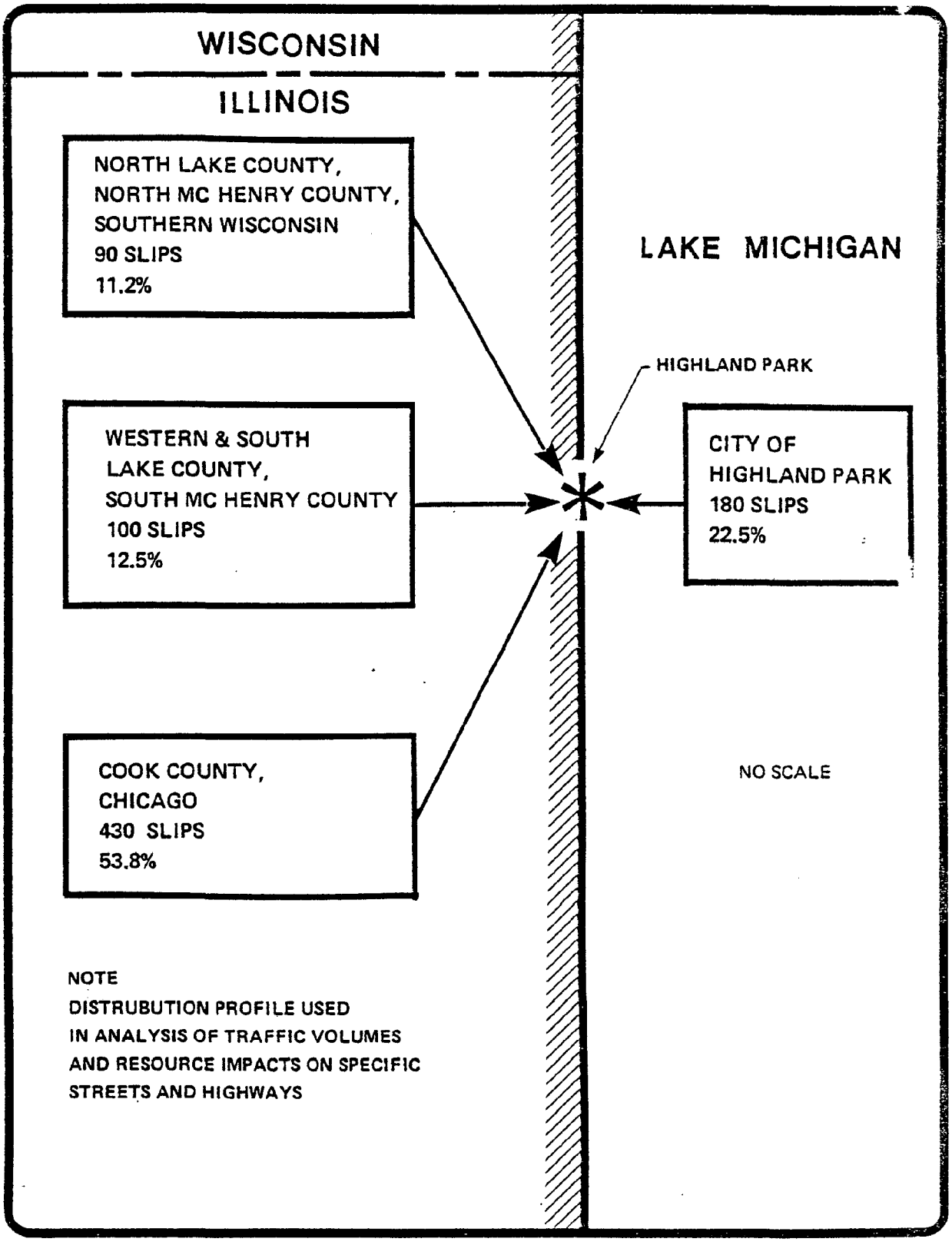


FIGURE 27 SOURCE OF DEMAND FOR 800 PERMANENT SLIPS

shops, sightseeing, launching ramps, chandlery, fishing, etc.). Weekend counts would be at the high end of the range, while weekday counts would be at the low end. Counts in the off-season periods would be substantially below the 6 trip figure.

Traffic impacts for the two marina locations were based entirely upon "in-season" factors. The impacts during the off-season were not considered, since they would be significantly lower and, therefore, of less concern.

Traffic generated by 800 permanently assigned berths would range from 4800 to 6400 ADT, with the probable sources as follows:

	ESTIMATED ADT RANGE	
From Residents of:	Low (Weekday)	High (Weekend)
Highland Park	1080	1440
No. Lake County, North McHenry County, and Southern Wisconsin	540	720
Western and Southern Lake County; South McHenry County	600	800
Cook County/Chicago	2580	3440
TOTAL ADT	4800	6400

Traffic Routes & Impacts

The two alternate marina locations were each separately evaluated to determine the likely streets which traffic would select as the preferred route between the marina and the areas of origin of the boat users. The expected traffic loads generated by the marina were then superimposed on the existing

traffic volumes and compared with acceptable street capacities.

Central Avenue Site

The selected Plan 6-1000R calls for a marina at the foot of Central Avenue adjacent to the Waterworks. For purposes of this analysis, access Scheme 7 was utilized (refer to Section D.3, pages 50 to 53 for details). This scheme proposes that (1) principal access be provided via Central Avenue and (2) a shuttle bus be employed to transport people from downtown Highland Park to the marina.

The extent to which a shuttle bus will be utilized by boat users and/or visitors to the marina is difficult to determine. Its usage will depend largely upon its convenience and frequency, its cost to the user versus the cost of parking fees at the marina, and the restrictions placed upon parking at the marina, if any. Because recreational boat users tend to carry provisions, articles of clothing, fishing gear, and other items of equipment to dockside and onto their boat when preparing to depart, they would normally prefer the convenience of parking nearby their berth. It is doubtful that a shuttle bus could furnish this level of convenience to the boat user. On the other hand, high parking fees or restricted parking could be used to discourage parking at the marina. Such a technique would probably not be acceptable to the restaurant operators or shop owners, since it would discourage potential patrons from visiting their businesses. It is unlikely that such patrons could be enticed into riding a shuttle bus to their evening dining spot, for example.

In order to fairly assess the vehicular traffic load, it was assumed that only approximately 5 percent of the visitors and

boaters would utilize the shuttle bus. If, in fact, the usage factor is ultimately higher, the vehicular traffic impact will be less.

The expected flow of traffic to and from the marina is shown in Figure 28. Additional boating season traffic volumes resulting from the operation of the marina at or near its capacity are shown for the major streets in the marina vicinity. Expected impacts are the greatest on Central Avenue and Deerfield Road, which will carry the major share of non-resident marina users. A summary of the expected traffic volume increases are shown in Table 18.

Walker Avenue Site

The alternate site location at Walker Avenue calls for a marina to be sited at the foot of Walker Avenue near Fort Sheridan. This site is somewhat less accessible, due to the steep bluffs. For the traffic analysis, it was assumed that entrance to the marina facility would be made at the present terminus of Walker Avenue. It was also assumed that a shuttle bus arrangement similar to that employed in Scheme 6-1000R would be utilized. The main parking area for those utilizing the shuttle bus would remain in downtown Highland Park.

The expected flow of traffic to and from the Walker Avenue marina site is displayed in Figure 29. Additional traffic generated by the marina during the boating season is shown for the major streets affected. The greatest impacts are expected to occur on Walker Avenue, Oak Street, Waukegan Avenue, and Prarie Avenue-Half Day Road. A summary of the expected volume impacts are shown in Table 19.

TABLE 18 CENTRAL AVENUE SITE TRAFFIC FLOW SUMMARY

Street	ADT[1] Existing Volume (1978)	Add'l Volume Imposed by Marina	Total Volume[2]	% Volume Increase
Central Avenue				
East of Linden	N.A.	5,200	--	--
Between Sheridan & Linden	N.A.	5,100	--	--
Between St. Johns & Sheridan	9,200	5,000	14,200	54%
Between Second & St. Johns	7,200	4,300	11,500	60%
Between Green Bay & Second	6,400	4,300	10,700	67%
Between Hickory & Green Bay	13,600	3,900	17,500	29%
Between Deerfield & Hickory	10,200	3,900	14,100	38%
Deerfield Road				
Between Central & U.S. 41	18,600	3,900	22,500	21%
West of U.S. 41	20,100	1,300	21,400	6%
Linden Avenue				
Between Central & Laurel	1,600	100	1,700	6%
Sheridan Road				
North of Park Avenue	3,400	100	3,500	3%
Between Park & Central	4,200	100	4,300	2%
Southeast of Linden	4,200	200	4,400	5%
St. Johns Avenue				
North of Elm Place	3,700	100	3,800	3%
Between Elm & Central	7,600	100	7,700	1%
Between Central & Laurel	9,200	400	9,600	4%
South of Laurel Avenue	7,200	400	7,600	6%
South of Sheridan Road	3,900	200	4,100	5%
First Street				
North of Elm Place	6,300	200	6,500	3%
Between Elm & Central	5,000	200	5,200	4%
Green Bay Road				
North of Central Avenue	13,500	100	13,600	1%
Between Central & Laurel	10,300	500	10,800	5%
Between Laurel & Deerfield	11,500	500	12,000	4%
Between Deerfield & Lincoln	10,000	500	10,500	5%
South of Lincoln	12,800	500	13,300	4%

[1] Average Daily Traffic, total vehicles-both direction

[2] Average Daily Traffic during 160-day boating season only

N.A. - Not Available

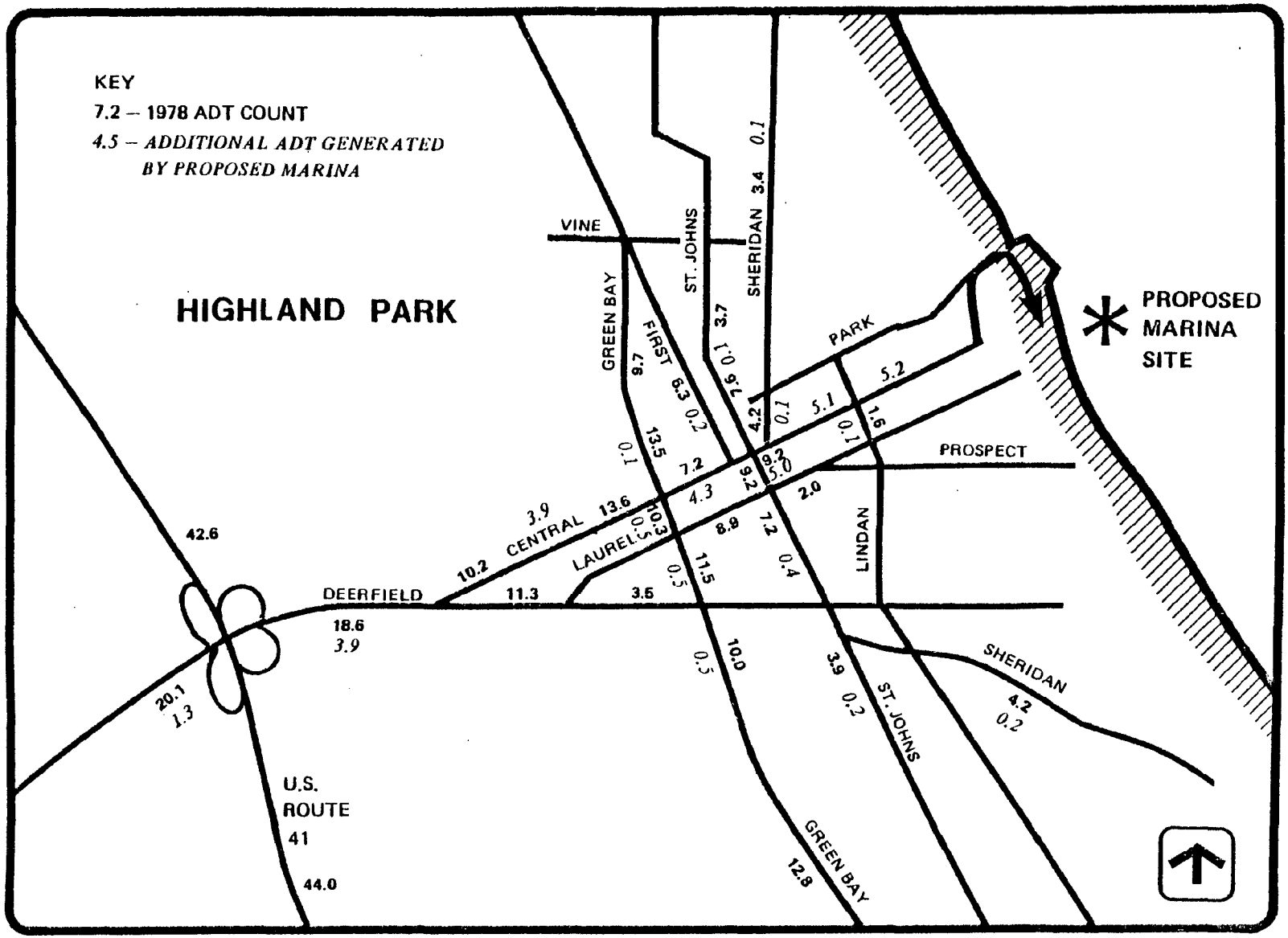


FIGURE 28 CENTRAL AVENUE SITE TRAFFIC FLOW ASSESSMENT

TABLE 19 WALKER AVENUE SITE TRAFFIC FLOW SUMMARY

Street	ADT Existing Volume (1978)	ADT Add'l Volume Imposed by Marina	ADT Total Volume[2]	% Volume Increase
Walker Avenue				
East of Oak Street	N.A.	5,200	--	--
Between Oak & Waukegan	3,500	3,500	7,000	100%
Waukegan Avenue				
North of Walker Avenue	N.A.	100	--	--
Between Walker & Highwood	8,000	3,400	11,400	43%
Between Highwood & Bloom	8,000	3,100	11,100	39%
Green Bay Road				
North of Highwood	10,800	300	11,100	3%
Prarie Ave.-Half Day Road				
Between Walker & Green Bay Rd.	8,300	3,400	11,700	41%
Between U.S. 41 & Trailway	10,500	3,300	13,800	31%
Sheridan Road				
North of Vine Avenue	3,400	1,400	4,800	41%
Between Elm & Central	4,200	1,400	5,600	33%
Central Avenue				
Between Sheridan & St. Johns	9,200	1,200	10,200	13%
Between Green Bay & Hickory	13,600	800	14,400	6%
BetweenHickory & Deerfield	10,200	800	11,000	8%
Deerfield Road				
Between Central & U.S. 41	18,600	800	19,400	4%

[1] Average Daily Traffic, total vehicles-both directions

[2] Average Daily Traffic during 160-day boating season only

N.A. - Not Available

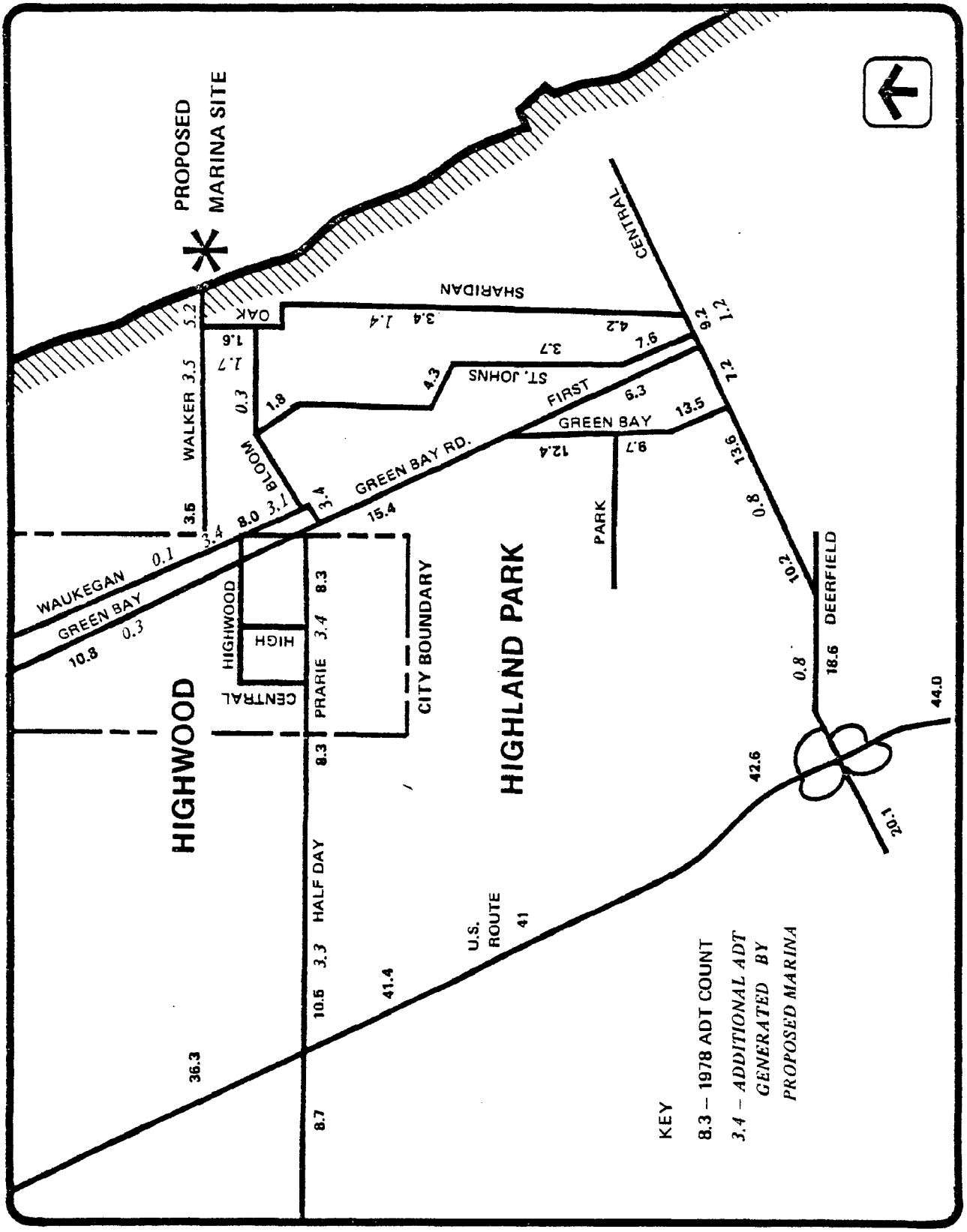


FIGURE 29 WALKER AVENUE SITE TRAFFIC FLOW ASSESSMENT

Road Capacities

All of the local streets impacted by the proposed marina are two-lane, two-way streets. It has been established that the ideal capacity of a two-lane road in both directions is 2,000 vehicles per hour, regardless of the distribution between lanes[1]. Factors which can significantly affect this ideal capacity are:

1. Lane widths and lateral clearances, physical obstructions, shoulders, auxiliary lanes, and similar physical factors.
2. Surface condition and road alignment; grades and terrain; restrictive sight distances.
3. Usage by trucks and busses and frequency and duration of parking, stopping, loading and unloading.
4. Traffic interruptions and interferences, including intersections, traffic signals and their cycle time, stop signs, railroad grade crossings, driveway entrances, and pedestrian interferences.

The downtown streets impacted by the Central Avenue marina location and the streets in the vicinity of Highwood impacted by the Walker Avenue scheme are particularly affected by the physical factors (Item 1) and traffic interruptions and interferences (Item 4). The precise extent to which the ideal capacity is reduced because of these factors should be determined by a qualified traffic engineer. It is likely, however, that the capacity of Central Avenue in its present form is insufficient to adequately handle the additional volume resulting from Scheme 6-1000R. Mitigating actions will be necessary to relieve potential peak time congestion problems. On the Walker Avenue Scheme, traffic flow problems will be encountered at the underpass at Prarie and Green Bay Road, where several turns will

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[1] Traffic Engineering, by Louis J. Pignataro, Prentice-Hall, Inc. 1973

be required. Furthermore, Prarie Avenue-Half Day Road is extremely narrow and contains many residential driveway entrances. The feasibility of imposing an additional vehicle load of 3400 ADT on this street without improving its physical condition should be studied by a qualified traffic engineer. Alternate routes to U.S. Highway 41 and Interstate 94 would present similar problems.

Economic Impacts/Benefits

The economic benefits, regardless of specific site location, which would result from the operation of the marina, will accrue substantially to the City of Highland Park, although region-wide benefits could affect surrounding communities as well, particularly Highwood, if the Walker Avenue site is chosen. The infusion of dollars earned elsewhere by boat owners and other visitors would be especially visible in the area of retail sales. Within Highland Park, these added sales can be segregated into two categories, i.e., (1) sales within the marina complex in the restaurants, shops, fuel dock, and chandlery and (2) additional sales at existing retail establishments in the city.

In the first category, retail sales resulting from the restaurants, snack bar, chandlery, and fuel station are forecasted to amount to between $3 and $4 million annually, most of which will occur during the 160-day boating season. Sixty percent of these sales will be in the food and beverage category, while about ten percent will be for fuel and related expenditures at the fuel dock in the marina. The balance is attributable to retail sales at the chandlery and ancillary shops in the marina complex. Expenditures within the proposed Yacht Club are not included because of the uncertainty in determining the ultimate structure and operation of the club.

Within the second category, benefits to existing businesses are projected to amount to another $3 to $4 million annually in retail sales. Most of these new sales (estimated at 75 percent) will occur at service stations and garages, while a smaller portion (15 percent) will be for food and beverage items, including groceries and deli items, liquor, soft drinks, and sundries. General merchandise stores will attract an estimated ten percent of this business, with visitors making local expenditures, for such miscellaneous articles as film, clothing, gifts and similar items.

In the aggregate, an increase in annual retail sales of $6 to $8 million can be expected as a direct economic result of the operation of the marina. An equal, but unidentified, amount of economic activity can be expected as a secondary result of these expenditures, providing additional employment and revenue for the community.

As part of the economic impact evaluation, consideration also has to be given to the inherent potential changes in property values. Traditionally the proximity of a marina/safe water harbor is a positive impact in the area. That is, property values in the general marina site vicinity tend to increase from 10 to 20 percent above normal property appreciation values. Variations from this increase exist where specific traffic impacts adversely impinge on residential properties or where marina activities directly affect existing property uses.

It is anticipated that some initial adverse property value effect will be felt in the Central Avenue residential area, but it may be mitigated effectively by proper design changes in the access roadway extension. If the Walker Avenue area is used as the marina site, access to more than 70 residences will be affected by the projected traffic increase - a much larger direct impact than in the Central Avenue area. This negative

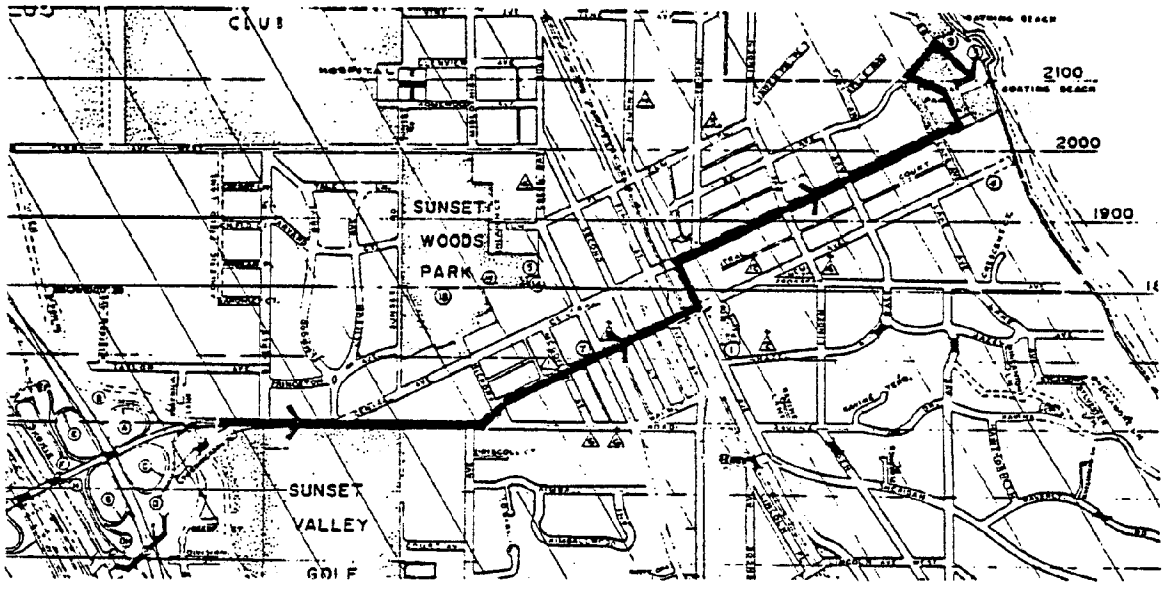
impact, however, will be offset by the direct proximity to the marina on a long term basis resulting in a general increase in property values above the normal appreciation rate.

Physical Location and Planning Considerations

Since the proposed island marina itself is not dependent on existing land-use in the area, and its general environmental impacts on the community are principally indirect-traffic and access routing become the most significant physical/planning constraints. For reasons of clarity, each site location will be discussed separately.

Central Avenue Site

Access to this site, as discussed earlier, is not direct, but using the recommended Scheme 7 access route with Park Avenue as the final approach leg, marina traffic can be accommodated reasonably well. Impacts from additional traffic on residential area on Central Avenue will be felt principally during peak user times during the boating season. Same will apply to the central business district (CBD) area on Central Avenue. Consideration should be given to rerouting of eastbound marina traffic in this area from Central Avenue CBD to Laurel Avenue (through the railroad underpass to St. Johns and then left to Central Avenue). See route below.



Walker Avenue Site

More direct access routes for marina users from westerly and southerly directions, arriving by U.S. Route 41 or State Route 22, cannot be expected to traverse the City of Highwood. Present condition and configuration of the business area, state of the existing roads, (particularly Green Bay Road and Waukegan Avenue) and nature of existing traffic preclude serious consideration of access other than via Sheridan Road from the south.

A second important site access obstacle is the steep grade change at Walker Avenue extension providing the final access leg to the marina site. Present grade exceeds 25 percent slope and would be difficult to use effectively and safely by cars trailering boats, trucks and service vehicles. The principal means of decreasing the road angle of approach to the site would involve an engineering solution of high cost and questionable environmental and planning acceptability. Alternatives to the above access approach could include acquisition of roadway right-of-way for Sheridan Road extension through B'nai Torah Highland Park Reform Temple property, or approaching the site through Fort Sheridan property along the shoreline. Neither of these alternatives appear to be acceptable at this time.

Conclusions

Conclusions of the above traffic impact analysis highlight the following:

1. Traffic Considerations

   From a traffic standpoint, it appears that the Central Avenue location is a more desirable alternative than the Walker Avenue location. Traffic on Central Avenue could be concentrated, to a large measure, to already developed commercial areas. Significant impacts upon residential neighborhoods would be confined to the eastern end of Central Avenue. In addition, safe, convenient access

onto U.S. Highway 41 is available at Deerfield Road. In the Walker Avenue scheme, traffic must pass through long portions of residential neighborhoods as well as adjacent to the Oak Terrace School on Prarie Avenue.

The existing road systems in the area can accommodate the added traffic if adequate signalization and traffic flow control measures are taken.

2. Economic Considerations

From the broad economic point of view, the increase in traffic in the area will produce a number of impacts:

a. General increase in direct and indirect yearly revenue to retail business in support of marina related activities in the order of $3 to $4 million direct (at the marina proper), $3 to $4 million indirect (in town retail sales) revenues.
b. Increase in property values of 10-20 percent in areas directly influenced by the marina location.
c. Some short-term decrease in residential property values in areas directly affected by marina access traffic. Expected to stabilize at higher-than-present levels in the long run (5 to 10 year period).

In general, most economic indicators are positive, accruing to the City of Highland Park additional revenues in excess of anticipated costs.

3. Physical Site and Planning Considerations

From a general siting and planning point of view, the Central Avenue site area is the preferred location for the proposed marina. Shifting the site to Walker Avenue

area will not significantly decrease the traffic impact in the central Highland Park area. Furthermore, the nature of the area through which the principal component of traffic would have to traverse in the City of Highwood is not compatible with the average daily peak traffic increases projected.

Another major planning concern is the steep access grade to the Walker Avenue site - it is our opinion that no readily available, practical engineering and environmental solutions exist to mitigate this condition.